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TWELFTH ANNUAL REPORT

OF

THE RESEARCH DEPARTMENT

OF THE

COFFEE BOARD

1958—1959

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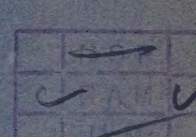

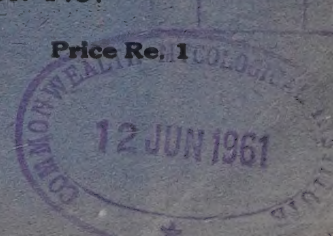

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MEMBERS OF RESEARCH COMMITTEE

As provided in Rule 18 (1) of the Coffee Rules 1955 the Board appointed a Research Committee for the period from 1-8-1958 to 31-7-1959 with the following Members:—

Shriyuts

M. Mallaraj Urs	Director of Agriculture, Mysore State. (*Chairman*)
A. Venkatesan	Director of Agriculture, Madras State.
P. M. Mathew	Director of Agriculture, Kerala State.
U. K. Lakshman Gowda ..	Planter
P. G. Gurjer	do.
R. Radcliffe	do.
M. Achuthan Nair	do.
M. S. P. Rajees	do.
K. M. Varghese Mapillai ..	do.
A. Ramanna	Member Representing Labour

COFFEE BOARD

RESEARCH DEPARTMENT

THE TWELFTH ANNUAL REPORT
1958-59

PART I

ADMINISTRATION

The Report covers the period from 1-8-1958 to 31-7-1959.

2. Dr. B. T. Narayanan was in charge of the Research Department throughout the year. The following officers continued to hold charge of the respective posts during the year:—

Dr. N. G. Chokkanna	Chemist
Sri. R. L. Narasimhaswamy ..	Botanist
„ K. V. George	Mycologist
„ B. S. Kuppuswamy	Agronomist (Reverted to his parent department from the afternoon of 2-1-1959)
Dr. P. Somasekhar	Entomologist
Sri. Lazar Soans	Secretary to Director of Research
„ S. Vishveshwara	Assistant Botanist
„ T. V. Pattabhiraman	Senior Liaison Officer
„ G. I. D'Souza	do.
„ B. K. Chandrappa	do.
„ W. Raghavendra Rao ..	do. (Development)
„ S. J. Mathias	Junior Liaison Officer
„ K. T. Bhagat	do.
„ H. S. Puttuswamy	do.
„ R. Vijaendraswamy	do.
„ K. C. Ananth	do.
„ L. V. Vaidyanathan	do. (Deputed to United Kingdom)
„ H. T. Ranga Setty	O.O.D. (Special Officer, P.P.T. Scheme)
„ H. Hanumantha Rao	Junior Liaison Officer
„ C. K. Ponnappa	do.
„ M. A. Balasubramaniam ..	do. (Under Training)
„ C. Ramakrishnan Nambiar ..	Superintendent.

3. Sri. B. S. Kuppuswamy, Agronomist, on Foreign Service from the Madras Agricultural Department, was reverted to his parent department from the afternoon of 2–1–1959.

4. Sri. P. K. Mathew, Assistant Chemist, continued as Assistant Soil Chemist, in-charge of Soil Testing Centre at Coffee Research Station, Balehonnur, under the expanded Soil Testing Service Scheme of the Government of India.

5. Sri. H. T. Ranga Setty, Junior Liaison Officer, has been appointed as Special Officer, Proprietary Products Testing Scheme, with effect from 6–8–1958 with Headquarters at Coffee Research Substation, Chethalli.

Extension Service

6. Dr. B. T. Narayanan was in-charge of the direction and supervision of the Liaison Service and continued to hold direct supervisory charge of the Shevaroys Liaison District.

7. A new Liaison District to cover the areas of coffee, coming within the boundaries of the erstwhile Travancore-Cochin State and the Nilambur area of the Malabar District in the South Kerala region, was constituted early in December 1958. This brings the total number of Liaison Districts to eleven.

8. Sri. Pattabhiraman, Senior Liaison Officer, Coimbatore, was in direct charge of the Coffee Areas on the Annamalais, Nelliampathies, Singampatti, Biligiris and Kanyakumari District. In addition to the supervisory charge of the Pulneys and Nilgiris Liaison Districts, the newly created South Kerala Liaison District was also attached to this division.

9. The Liaison Divisions of North Mysore and South Mysore continued to function without any change during the year under report. Due to the paucity of the staff the Senior Liaison Officers Sriyuths G. I. D'Souza, and B. K. Chandrappa of South and North Mysore Divisions held additional charge of the Liaison Districts of North Coorg and Saklespur respectively, till July 1959. Consequent to the recruitment of additional Junior Liaison Officers, they were relieved of their direct charge during the second half of July 1959.

10. Sri. W. Raghavendra Rao, Senior Liaison Officer (Development), continued to work under the Coffee Development Plan with Headquarters at Balehonnur. Koppa-Sangameswarpet-Magundi Liaison District continued to be under his direct additional charge.

11. Sri. L. V. Vaidyanathan, Junior Liaison Officer, has been deputed for training in United Kingdom in Radioactive Tracer Studies, under the Colombo Plan, with effect from 25–3–1959.

12. Sri. C. K. Vasudevan, Research Assistant in Entomology, who has been appointed as Officiating J.L.O., Shevaroys, *vice* Sri. L. V. Vaidyanathan, reported for duty on the forenoon of 2–5–1959.

13. Sri. K. R. Ahobala Rao, Sri. K. Haridas Menon and Sri. P. K. Ramachandran, Liaison Assistants under the Development Plan, were selected and appointed as temporary Junior Liaison Officers, with effect from 18th, 16th and 20th July 1959 respectively.

14. Sri. M. A. Balasubramaniam, who was appointed as Junior Liaison Officer, reported for duty on 3-2-1959 and was under training at the Coffee Research Station, Balehonnur, and in a private estate till the end of the year.

15. Sri. C. K. Ponnappa, Junior Liaison Officer, on completion of his training was posted to be in independent charge of the South Kerala Liaison District with Headquarters at Kottayam and joined duty on 4-2-1959.

The Statistical Assistant Sri. C. Ganapathy resigned his post and was relieved on 27-6-1959 afternoon. The post remained vacant till the end of the period.

16. The officers and staff on duty on 31-7-1959 and the sanctioned strength are as follows:—

Category	Sanctioned Strength	No. Working
Class I	1	1
Class II—		
Heads of Sections	5	4
Assistant Research Officers ..	3	1
Senior Liaison Officers	4	4
Junior Liaison Officers	12	12*
Farm and Administration	3	2
Special Officer	1	1
P.P.T. Scheme	..	..
Class III—		
Technical	102	66
Ministerial	38	37
Class IV—		
Peons, Attenders, Drivers, etc. ..	42	40
TOTAL ..	211	168

* Including one under Training.

The details of the various posts and categories are given in Appendix I. Proposals for the reorganization of the Research Department to ensure both qualified

man-power and material and equipment have been approved by the Research and Executive Committees of the Board. They are under consideration of the Government of India.

17. During the year the following posts were filled either after advertisement or by transfer from other Departments of the Board:—

Junior Liaison Officers	4
Research Assistants	2
Fieldmen	8
Ministerial Staff	Nil
Class IV—	
Peons, Attenders, etc.	5

A project with special staff for working on cytological, embryological, morphological and co-ordinated observational studies on station selections began functioning from August 1958.

Leave

18. The following officers were on leave during the year for the periods noted against each:—

Sri. R. L. Narasimhaswamy, Botanist	11	days
„ K. V. George, Mycologist	15	„
„ B. S. Kuppuswamy, Agronomist	8	„
„ B. K. Chandrappa, Senior Liaison Officer ..	46	„
„ W. Raghavendra Rao do. ..	4	„
„ H. S. Puttuswamy, Junior Liaison Officer ..	142	„
„ S. J. Mathias do. ..	17	„
„ K. T. Bhagat do. ..	44	„
„ R. Vijaendraswamy do. ..	19	„
„ K. C. Ananth do. ..	93	„
„ Lazar Soans, Secretary to Director of Research	20	„
„ C. Ramakrishnan Nambiar, Superintendent ..	23	„
„ H. T. Ranga Setty, Special Officer, P.P.T. Scheme	19	„

The several technical and ministerial staff were on earned leave for varying periods during the year.

Tours

19. Dr. B. T. Narayanan was on tour for 224 days in the year to attend the Meetings of the Board and its Committees and to visit coffee areas in Mysore,

Coorg, Wynaad, South Kerala, Nilgiris, Shevaroys and Coimbatore. The visits to the Liaison Zones were mainly for advisory work in problem areas, inspection of the working of the demonstration and exploratory trial plots, selection of site for and to organize Field Regional Stations. The assay of programmes of the schemes under the Development Plan formed an invariable part of these visits. He visited over 100 big plantations and about 200 peasant holdings. The Sub-station at Chethalli was visited six times covering a total stay of 20 days during the year for inspection and conduct of research. At the request of the West Bengal and Assam Governments, Dr. Narayanan undertook a survey tour of the Cinchona Plantations in West Bengal and the tribal areas in the hill tracts of Assam State for examining the progress of the pilot projects on coffee and for exploring the possibilities of coffee cultivation in these areas. He attended the Conference convened by the Soil Testing Centre of the Southern Zone at Madras during the first week of July 1959. He also attended the meeting of the Agricultural and Food Products Council (AFPC) of the I.S.I. during March 1959.

20. The Heads of Research Sections were on tours for the periods noted below against each:—

Dr. N. G. Chokkanna, Chemist	.. ..	108 days
Sri. R. L. Narasimhaswamy, Botanist	.. ..	70 „
„ K. V. George, Mycologist ..	.. ..	35 „
„ B. S. Kuppuswamy, Agronomist	.. ..	24 „
Dr. P. Somasekhar, Entomologist	.. ..	41 „

Tours in the several Liaison Districts were undertaken in connection with technical advisory work, visits to Sub-station, Chethalli, inspection of seed blocks of station selections, collection of promising material for breeding work and inspection of experimental plots already working and to lay out new experiments. The Chemist in addition to this programme of visits to coffee areas, participated in the several important exhibitions in the South, and also the "India 1958" Exhibition held at Delhi.

In connection with the schemes for introduction of Coffee Cultivation in hill districts and agency areas of Andhra Pradesh and Orissa, a preliminary survey was undertaken by Sri. W. Raghavendra Rao, Senior Liaison Officer, during March 1959. The areas were again visited in June 1959 by Sri. Tenneti Viswanatham, Chairman, Coffee Board, accompanied by Officers of the Marketing and Research Department.

21. The Assistant Research Officers, the Research Assistants and the Field Staff, attached to the several technological divisions, were deputed to experimental and problem blocks in the different Liaison Districts for execution of the programme of work.

Construction of Building, etc.

22.1. The constructional work at this Station was in-charge of Public Works Department of the Government of Mysore, as reported earlier. Three twin-quarters, 2 senior staff quarters, one workshop and one farm stores were in advanced stage of construction. Two drying yards, one with tile and the other with cement concrete flooring were constructed departmentally during this year.

22.2. Annual repairs to staff and labour quarters, laboratory, rest houses and other general buildings in the Station including the sanitary works were carried out by the department.

22.3. At Coffee Research Sub-station, Chethalli, the extension to the Laboratory building dealt with in the previous report was completed. A twin-type quarters to accommodate Class III staff was under construction.

Water-supply

22.4. A well at nursery site was sunk and it was equipped with necessary pump-set fixed in a pump house. It is estimated that this well would supply about 25,000 gallons of water per day (24 hours).

22.5. The other maintenance work of water filters, wells, etc., were attended to as usual.

Library

23. The Research Department of the Coffee Board was enrolled as a Member of the Indian Association for Special Libraries and Information Centre, Calcutta. During the year six journals were newly added bringing the total number of subscribed journals to 84. Thirty journals were received on an exchange basis.

24. Two hundred and twenty-four books were added to the Library during the year of which eight books were received as gifts from individuals and institutions. One hundred and eighty-two books were purchased, thirty-four volumes of occasional publications, 141 loose volumes of old journals were bound and added on to the book section, thus bringing the total number of books in the Library to 1,357. A total of ninety-seven volumes of standard books of reference on soil management, plant protection, botany and horticulture were purchased and supplied to the various officers of the Liaison Districts and Divisions.

25. The officers and staff of the Research Department made full use of the increased facilities available in the library for study and reference work.

Meetings

26. Dr. B. T. Narayanan attended 2 meetings of the Board, 3 meetings of the Research Committee, 4 meetings of the Executive Committee, 4 meetings of the Development Committee, 2 meetings of the Quality Committee and the Annual Conference of the United Planters Association of South India at Coonoor. Two

staff conferences of the Officers of the Technical and Extension Wings of the Research Department were held at Coffee Research Station, during June and August 1959, to discuss and to review the programme of Research, Extension and Administrative matters and other cognate subjects.

27. Informal discussions with the Heads of Sections were held at frequent intervals, and with the Superintendent, Coffee Research Sub-station, Chethalli. A Conference of the Divisional Officers of the Extension Services was also held in March 1959 at Coimbatore to discuss matters in connection with the administration, jurisdiction, etc.

Exhibitions and Conferences

28. A field day was held at the Coffee Research Sub-station, Chethalli, on the 20th and 21st December 1958. Over 600 planters from various coffee zones, representatives of firms and others interested in the industry participated. Visits to estate in the mornings and to the laboratory and exhibitions in the afternoons, followed by an assembly dealing with coffee problems, were held.

29. The Research Department participated in the U.P.A.S.I. Exhibition at Coonoor, the Exhibition held in connection with Cattle Show at Mudigere and the "India 1958" Exhibition at Delhi. An exhibition was also arranged ancillary to the field day held at Coffee Research Sub-station, Chethalli.

Representatives of the Research Department participated in the Convention of the Indian Standards Institution held at Delhi and the Conference convened by the Soil Testing Centre of the Southern Zone at Madras.

Correspondence

30. With the increased tempo of the Liaison Services due to realignment and formation of new districts, the correspondence handled at the main Research Station shows an overall increase over last year. The number of advisory letters issued from the two Research Stations have also increased considerably, indicating the awareness of the planters to the day-to-day problems on coffee culture.

Budget

31. The budget provisions for the financial year 1958–59 anticipated a programme of expenditure of Rs. 3,54,100 under capital works and Rs. 9,81,300 under recurring expenditure inclusive of estate maintenance. An actual expenditure of Rs. 2,36,050 under capital charges and Rs. 7,87,694 under recurring charges was incurred during the same period. The savings under recurring expenditure were mainly due to observance of strict economy in the various sections of the department, the hardening import restrictions for purchase of equipment and not filling sanctioned posts. The details of the budget are furnished below:—

	Budget provisions for 1958–59		Actual expenditure for 1958–59	
	Capital Rs.	Recurring Rs.	Capital Rs.	Recurring Rs.
Research and Extension	3,52,100	7,61,400	2,35,680	6,31,997
Development ..	2,000	2,19,900	370	1,55,697

32. The budget provisions for the year 1959–60 under both the Research and Development Schemes are as follows:—

	Capital charges Rs.	Recurring expenditure Rs.
Research and Extension	6,01,500	8,48,100
Development	3,000	2,52,000

The expansion of liaison services, starting of new projects, provision for construction of administrative officers and other buildings and the purchase of sprinkler irrigation units have all accounted for increased expenditure proposed by the department.

33. The revenue receipts anticipated and actually realised for the year 1958–59 and the estimated receipts for the year 1959–60 are given below:—

	1958–59 Anticipated Rs.	1958–59 Actual Rs.	1959–60 Estimated Rs.
Research and Extension ..	2,53,500	2,42,878	2,74,500
Development	40,000	41,446	40,000

34. The audit of the accounts for the year 1957–58 of the two Research Stations at Chethalli and Balehonnur were conducted during November 1958 and February 1959 respectively. The Accounts Officer of the Board also conducted physical verification of accounts at the above two Stations.

Visits

35. The Coffee Research Stations at Balehonnur and Chethalli received many planters and others interested in the planting industry. As already reported the trend of big and small planters visiting the Stations either with the Liaison Officers of their division, or of their own accord was on the increase.

35.1. The District Adult Education Officer during his visit projected six films on cultural and educational subjects.

35.2. A party of tribal delegates from the several hill areas of Assam accompanied by the Senior Conservator of Forests, Assam State, visited the two Research Stations during December 1958, to study the details of cultivation of coffee.

35.3. A party of Block Development Officers from several States visited the Coffee Research Station, Balehonnur, during March 1959.

35.4. Students of the Agricultural Colleges, Hebbal and Dharwar, visited the main Station during the year as part of their annual training in plantation crops.

35.5. The Expert Committee on Coffee Marketing visited the main Station at Balehonnur during October 1958.

36. The Stations were privileged to receive the following distinguished visitors:—

1. Honourable Captain Sri. Williamson Sangma, Minister for Tribal Affairs, Transport and Publicity, Assam.
2. Sri. S. Ananda Rao, Chief Scientific Officer, U.P.A.S.I., Scientific Department, Coonoor.
3. Sri. Ananthapadmanabha Rao, State Statistician, Mysore State, Bangalore.
4. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
5. Sri. C. S. Ramachandran, I.C.S., Joint-Secretary, Ministry of Commerce and Industry, Government of India, New Delhi.
6. Sri. K. Srinivasan, I.A.S., (Retd.) Chairman, Coffee Board.
7. Dr. Gilbert R. Muhr, Soil Testing Adviser, Government of India, New Delhi.
8. Sri. Tenneti Viswanatham, Chairman, Coffee Board.

The Research Department is indebted to the Hon'ble Minister, Assam Government and the Officers of the Union and State Governments for their visits to the Stations and the interest evinced by them.

Training in Coffee Culture

37. Under the Scheme for the training of personnel in the methods of coffee cultivation, the following underwent, the first phase of the training:—

1. Sri. K. G. Appiah ... Private Candidate
2. „ K. G. Choudhari A Nominee of the Bombay Government.

3. Sri. Pallal L. Sanga .. Nominee of Assam Government.
4. „ N. Brahma .. do.
5. „ G. N. Rao .. Private Candidate
6. „ M. C. Ponnappa.. do.

Sri. I. K. Lama, a Nominee of the West Bengal Government and Sri. R. Subramaniam, a Private Candidate completed the second and last phase of their training during the year. In addition, three members of the staff who were newly recruited during the year were given training in the farm and in the several technological sections for periods ranging from one to three months prior to their further assignment.

Exchange of Seed Material

38. The following seeds of different species, types and forms of coffee were received during the year under report. Mention may be made of the species *Psilanthopsis kopakata*, from Horticultural Crops Research Branch, Beltsville, Maryland, U.S.A.; seven types of arabica from Dr. Branquinho d' Oleiverira, Portugal, through the courtesy of Mr. C. A. Krug, F.A.O., Rome; and six forms of arabica from the Director, Instituto Agronomico Do Estado De Sao Paulo, Campinas, Brazil. The material received from Portugal is said to be resistant to the *Hemileia vastatrix* races I, II and IV (W. W. Mayne's) except one type.

Publications

39. The following were the publications issued by the Research Department, during the year:—

Scientific Articles: (*a*) *Indian Coffee*

1. "Notes on Insects Associated with Coffee", by C. K. Vasudevan and Dr. B. T. Narayanan, September 1958.
2. "Investigations on the Vegetative Propagation of Coffee", by B. S. Kuppuswamy, November 1958.
3. "Some Observations on the Shade Experiments at the Coffee Research Sub-station, Chethalli", by B. S. Kuppuswamy, November 1958.
4. "Survey and Improvement of Coffee Cultivation on the Pulneys", by K. C. Ananth and P. K. Ramachandran, November 1958.
5. "Tender Berry Borer", by K. C. Ananth and P. K. Ramachandran, April 1959.
6. "Control of Cardamom Hairy Caterpillar", by Dr. P. Somasekhar June 1959.

(*b*) *Other Journals*

1. " 'Target Leaf Spot' Disease of Coffee—Occurrence—Symptoms and Etiology", by Sri. T. R. Nagaraj and K. V. George, *Indian Phytopathology*, 1958, **11** (2).
2. "Preliminary Studies of the Effects of Gibberellic Acid on Arabica Coffee Seedlings", by B. S. Kuppuswamy and Dr. B. T. Narayanan, *Science and Culture*, October 1958, **24** (4).
3. "Nematodes Associated with Arabica Coffee in India", by Dr. P. Somasekhar, *F.A.O. Monthly Plant Protection Bulletin*, March 1959.

Popular Articles in Indian Coffee

1. "Coffee Cultiavation in India, Chapters 5 to 8—August, September, October 1958; March, April, May, June 1959.
2. "Coffee Grafting", May 1959.
3. "Preparation of Plantation Coffee", July 1959.

Booklets

1. *Questions and Answers on Coffee Cultivation*—Compiled from *Indian Coffee*, 1950 to 1958.
2. *Pests of Coffee and their Control*—Compiled by Dr. P. Somasekhar, Reprinted in Booklet form from *Indian Coffee*, June 1958, Priced.
3. *Guide to Coffee Research Sub-station, Chethalli.*
4. *Coffee in India—Planters' Guide and Calendar*—Priced.

Reports, Abstracts and Hints

40. Monthly practical hints to planters, timely plant protection warning notes and brief abstracts from reports, bulletins and scientific journals dealing with coffee and related subjects were regularly published in the *Indian Coffee*, *A Guide to the Research Sub-station, Chethalli*, giving details of experimental plots and the estate, was published on the occasion of the Field Day. The Eleventh Annual Report of the Research Department of the Coffee Board was prepared and printed.

41. A brief note on the work done by the Research Department in 1958–59 was prepared and sent to the Ministry of Commerce and Industry, Government of India. A brief technical report on Research Work of the Department was also sent to the Ministry of Food and Agriculture, Government of India, and the Secretary, Indian Council of Agricultural Research, New Delhi.

Acknowledgments

42.1. I am deeply grateful to the Director, Central Food Technological Research Institute, Mysore, for so generously assisting us in the maintenance and

repairs of many of our precision instruments and for the courtesy of allowing us laboratory and library facilities. The Institute also trained 3 members of the Department in moisture assay of coffee in the raw to evolve and develop a method for specifying moisture standards in incoming coffee at curers. To Dr. Bhatia, Mr. Natarajan and others of the Food Processing Department my grateful thanks are due.

42.2. The Department and I are under a debt of gratitude to Sri. R. Radcliffe of Ossoor Estate, Saklespur and Sri. A. Ratnam of Kottaram Plantations, Kalpetta, Wynaad, for making available valuable land to start Regional Stations. Their continued assistance in the further progress of the Stations is evidence of their abiding interest in this important programme of the Department. We are equally grateful to the Governments of Mysore and Kerala States and the local Revenue authorities in Mercara and Calicut for the expeditious manner in which the lands were transferred to the Department.

42.3. The Department is indebted to the Government of the United Kingdom for the generous gift of equipment and books valued at over £ 680 donated as a technical aid under the Colombo Plan.

43. At the time of writing this report, Dr. B. T. Narayanan has proceeded on (terminal) leave on retirement from the service of the Board. I am to convey to all sectors of the Industry, the Planters Associations, the wide circle of planter friends in the various coffee districts, sister technical institutions and the several State Departments of Agriculture his personal expressions of gratitude for the courtesy and consideration extended to him so generously during his association with them. Their co-operation and enthusiastic response gave encouragement and support to the work. To the sister departments of the Board, he is beholden for ready assistance and a willing and ready exchange of information. No tribute is adequate to express the sense of his indebtedness to all categories of staff of the Research Department, that loyal band of informed, enthusiastic and devoted workers, to be associated with whom will always be remembered as a cherished privilege.

44. Brief reviews of the work done in the estates and in the different Liaison and Scientific Divisions together with detailed sectional reports are given in the following pages.

N. G. CHOKKANNA,
Director of Research.

PART II

REPORT ON THE WORKING OF THE ESTATE AT THE COFFEE RESEARCH STATION, BALEHONNUR AND COFFEE RESEARCH SUB-STATION, CHETHALLI

There were no changes in the staff of the farm sections and Sriyuths T. H. Thimme Gowda and C. Ramakrishnan Nambiar continued as Farm Assistant at the Coffee Research Station, Balehonnur and Superintendent at the Coffee Research Sub-station, Chethalli, respectively. Sri. B. Swaminathan, Plant Protection Assistant, was in-charge of the current duties of the Superintendent, Coffee Research Sub-station, Chethalli, when the latter was on earned leave from 9–7–1959 to the end of the period under report. The other technical and ministerial staff attached to these sections were on leave for short periods during the year.

Season and Climate

2. The Coffee Research Station, Balehonnur, received a total rainfall of 137·33 inches (3,487·8 mm.) on 127 rainy days as against 135·48 inches (3,441·4 mm.) received on 149 rainy days for the corresponding period in the previous year and against 113·69 inches (2,887·7 mm.) and 105·57 inches (2,681·5 mm.) being the averages for the past ten and thirty-two year periods respectively. The rainfall during the year under report was thus 1·85 inches (47·0 mm.) in excess of the previous year and 23·64 inches (600·5 mm.) over the decennial average.

3. The South-West Monsoon of 1958 set in early by the last week of May and strengthened by the middle of June. The months of July and August continued to be the wettest months contributing 73·93 inches (1,877·8 mm.). The monsoon weakened by the middle of September and the month of September was fairly bright. After an early start in the first week of October the North-East Monsoon tailed off during third week of November, with erratic trends giving a total of 6·65 inches (168·9 mm.). After the cessation of the monsoons, perhaps the longest dry period of 136 days was experienced and the first summer showers were received on 11th April 1959. The blossom showers for the year 1959 were received in the second week of April 1959 resulting in only a portion of arabica blossom opening. The rest opened out from the showers received in the third week of the month. The backing showers received during May helped in the revival of the bushes after prolonged drought and in the production of profuse flush in arabica; on the other hand, the robusta blossoms opened out in full and considerable shedding of fruit initials was noticed due to the much delayed receipt of blossom showers and rain on the blossoming day. It was also noticed that the production of new flush was limited in robusta. The monsoon for the year set in by the middle

of June 1959, continued to be unusually active during the months of July and August, the total precipitation being 90·99 inches (2,311·1 mm.).

4. At the Sub-station, Chethalli, a total rainfall of 88·82 inches (2,256·0 mm.) was recorded during the year against 75·78 inches (1,924·8 mm.) for the corresponding period of the previous year. The first blossom showers were received in the first week of April 1959. Due to the belated and insufficient showers the blossom was patchy; paddying of the buds was also observed. A minor blossom occurred in response to scanty showers recorded in the last week in April. The second blossom, however, occurred from substantive showers which fell in the first week in May 1959; later backing showers were frequent and helped in a good setting.

Incidence of Diseases and Pests

5. At the Coffee Research Station, Balehonnur, the incidence of leaf disease during the year 1958 was comparatively high. The prolonged dry weather conditions from November 1958 to middle of April 1959 brought about a more or less complete defoliation of all the affected leaves and as a result of this paucity of disease inoculum, the disease spread so far is very low.

The unusually heavy rains during the month of July 1959 acted as a check on the spread of the disease. However, in view of the low crop carried and natural better flushing of the bushes it is expected that towards the close of the monsoon a timely post-monsoon spraying may become necessary.

6. The incidence of black-rot was comparatively more this year. Damping off of seedlings in the nursery continued to be low. However a sudden outbreak of 'brown eye spot' disease in the nursery and young clearings during June 1959 was noticed. A mild incidence of 'Kondli' disease was also observed during August and September 1958 in the nursery seedlings. Prompt attention to handling of diseased material, timely regulation of shade and phytosanitary measures as part of the routine cultural operations in the estate and in the nursery have checked and controlled the above maladies.

7. Incidence of white stem-borer during the year was negligible. The regular programme of rigid tracing of borer-affected plants and swabbing of B.H.C. just prior to the flight periods have been responsible for effectively keeping the pest under check. Incidence of shot hole borer in the general estate of Coffee Research Station, Balehonnur, for 1958–59 was 16·57% less than that of previous season. Independent tracing for red borer showed that the incidence reached a peak in May 1959 with N.M.S. Block V showing the maximum degree of incidence and the percentage recorded per acre was 3·13. Minor pests like leaf-eating caterpillars, leaf miners, etc., did not present any serious problem.

8. At the Coffee Research Sub-station, Chethalli, the leaf disease incidence was rather mild during the season under report. Timely spraying helped to a great extent in arresting the spread of the disease and the carry-over of healthy leaves throughout the year was appreciable. Regular tracing of borers and timely

swabbing of insecticides have kept the incidence of white stem-borer low. The incidence of green bug and other pests on coffee was much below the pest level. However, it was noticed that the incidence of red-borer was increasing during this season.

Area—Replanting and New Clearing

9. The two Stations cover an area of nearly 560 acres (293 acres in Balehonnur and 268 acres at Chethalli) of which areas under coffee are given below:—

	Planted area in acres		Bearing area in acres	
	Arabica	Robusta	Arabica	Robusta
Balehonnur ..	112·74	31·76	89·44	29·00
Chethalli ..	111·31	10·04	101·08	10·04

10. In furtherance of the policy of replacing old uneconomical and pest-ridden coffee, an area of 3·00 acres in 'O' Block was cleared at Balehonnur and planted with Station Selections, crosses and selfs during the year. An area of about one acre was cleared at the Sub-station, Chethalli, for laying out a trial on planting pit dimensions.

Crop

11. The yield of uncured coffee harvested during the year is as follows:—

	Yield of coffee in bushels (uncured)											
	Balehonnur						Chethalli					
	Arabica		Robusta		Tree coffee		Arabica		Robusta		Tree coffee	
	Bs.	Sr.	Bs.	Sr.	Bs.	Sr.	Bs.	Sr.	Bs.	Sr.	Bs.	Sr.
A. Parchment ..	290	02	520	0	..	..	2,000	0	..	..	..	..
B. Cherry ..	1,811	13	352	14	117	0	2,597	24	171	8	..	..
C. Gleanings and bits	221	0	130	14	..	..	269	8	9	24	..	..
D. Others including seed coffee	59	6¼	86	09	1	10	..	..	..	..	..	..
TOTAL ..	2,381	21¼	1,088	37	118	10	4,867	0	181	0	..	..
Yield of clean coffee in tons	18·91		11·48		0·75		25					

12. A crop of 18·91 tons of arabica, 11·48 tons of robusta and 0·75 ton of tree coffee aggregating to 31·14 tons was harvested during 1958–59 season as against an estimate of 22 tons, 11 tons and ½ ton of arabica, robusta and tree coffee respectively at Coffee Research Station, Balehonnur. The crop prospects for 1959–60 are estimated at 16 tons of arabica, 4 tons of robusta and ¼ ton of tree coffee.

13. At the Coffee Research Sub-station, Chethalli, a crop of 25·00 tons was harvested during the year as against an estimate of 30·00 tons on blossom. The blossom estimates for the year 1959–60 are placed at 33 tons.

Seed Distribution

14. Apart from the seed blocks of both the Stations, the Zonal seed plots in private estates were continued to meet the increasing demand for seeds of the Station selections. Seven estates in Mysore Zone and one on the Nilgiris continued to work as regional seed plots. Seed coffee was prepared under the strict supervision of the Research Department. The quantity of seed coffee collected from the above sources is given below:—

Source	Arabica in lb.	Robusta in lb.	Tree coffee in lb.
1. Coffee Research Station, Balehonnur ..	818	1,324	52
2. Coffee Research Sub-station, Chethalli	2,058	..	..
3. Zonal seed blocks	5,059	..	..
TOTAL ..	7,935	1,324	52

15. A total quantity of 7,746 lb. arabica, 1,128 lb. of robusta and 32 lb. of tree coffee seeds were distributed to 2,205 planters during the year 1958–59 as against 13,504 lb. of arabica, 814 lb. of robusta and 14 lb. of tree coffee seeds distributed to 2,529 planters in the previous year.

Paddy and Other Crops

16. In the wet-land paddy was grown over an area of 2·2 acres at Coffee Research Station, Balehonnur and 6·0 acres at Coffee Research Sub-station, Chethalli. A comparative statement of the yield obtained at these two Stations are given below:—

Station	Area in acres	Yield of grain in lb.		Yield of straw in lb.	
		1957–58	1958–59	1957–58	1958–59
Coffee Research Station, Balehonnur ..	2·25	3,235	5,449	7,350	7,500
Coffee Research Sub-station, Chethalli	0	15,072	13,512	9,500	10,400

17. The prospects of the orange crop based on blossom as well as subsequent estimates were not satisfactory. A sum of Rs. 2,519·86 was realised as against Rs. 7,336·00 obtained during the previous year. The prospects for the coming year was observed to be not satisfactory.

Miscellaneous

18. Both the Stations continued to be members of the U.P.A.S.I. and the Regional Planters' Associations. The Sub-station was also a Member of the Coorg Orange Growers' Co-operative Society.

19. The labour strength at Coffee Research Station, which was 159 at the end of last year, closed with 162 at the end of the year against a sanctioned strength of 170. The average labour out-turn was 72% during this year as against 73·6% of last year. The labour strength at Coffee Research Sub-station, Chethalli, was 95 as against the sanctioned strength of 130. The Employer-Employee relationship continued to be cordial and happy at both the Stations. As usual, the Independence Day and the Republic Day were conducted in a befitting manner and holidays with wages were declared at both the Stations. The mazdoors took part in the entertainments, sports and refreshments.

20. A Canteen was run at Balehonnur for the benefit of the mazdoors. The creche for the children at Chethalli continued to be maintained. Milk for babies and midday meals for non-working children were provided.

A Radio was working at each of the Stations. Screening of films of technological and rural interests was arranged for the benefit of the staff and the mazdoors and eight such were shown during the year. On account of the opening of a Government Group Hospital at 10th mile township in September 1958 the staff and mazdoors of Coffee Research Sub-station, Chethalli, began to avail this facility extended to them. The services of the cart was made available for conveying the school-going children at the Sub-station, Chethalli, to the Higher Elementary School at the 10th mile township, a distance of one mile from the Station.

N. G. CHOKKANNA,
Director of Research.

PART III

EXTENSION SERVICE

The Director of Research was in over-all charge of direction, supervision and co-ordination of the Extension Services.

2. A new Liaison District (South Kerala), to cover the areas of coffee coming within the boundaries of erstwhile Travancore-Cochin State and certain isolated pockets in the Malabar District was constituted early in December 1958. This brings the total number of Liaison Districts established so far to eleven.

3. The Liaison Divisions of North Mysore and South Mysore continued to function without any changes during the year under report.

4. The newly formed South Kerala Liaison District was attached to the Coimbatore Liaison Division. Thus, the Senior Liaison Officer, Coimbatore, was in direct charge of the coffee areas in the Annamalais, Nelliampathies, Singampatti Hills, Kanyakumari District and Bilgiris in addition to the supervisory charge of the Liaison Districts of Pulneys, Nilgiris and South Kerala. Due to paucity of staff, the Senior Liaison Officers, North and South Mysore Divisions, held additional charge of the Liaison Districts of Saklespur and North Coorg respectively till July 1959. The Koppa Liaison District continued to be under the direct charge of the Senior Liaison Officer (Development) stationed at the Coffee Research Station, Balehonnur.

5. Schemes for introduction of coffee cultivation in the hill districts and agency area of Assam, West Bengal, Andhra Pradesh and Orissa States recorded further progress during the period under report. The pilot projects of coffee organised by the Forest Departmental authorities in Assam State and the Cinchona Directorate in West Bengal State were visited during October 1958 by Sri. K. Srinivasan, I.A.S. (Retd.), the then Chairman, Coffee Board, and Dr. B. T. Narayanan, the Director of Research. The progress of growth of coffee in these initial project plots was assessed. In consultation with the concerned Governmental and departmental authorities, plans and programmes for further extension to new areas were drawn up for implementation. The crop obtained from the pilot projects were tested for quality factors. A delegation headed by Captain Williamson Sangma, Minister for Tribal Areas, Assam State, and consisting of officers of the Forest Department, Chief Executive Members of the autonomous district councils and tribal kisans visited the coffee-growing areas in South India to get a picture of coffee cultivation. The liaison ties have been further strengthened by frequent exchange of letters and issue of advisory notes. A survey for judging the suitability of the Agency areas of Andhra Pradesh was undertaken by the Senior Liaison Officer (Development) of this Department during March 1959.

The areas were subsequently visited by Sri. Tenneti Viswanatham, Chairman, Coffee Board, accompanied by officers of the Marketing and Research Departments in June 1959. A report of survey together with the recommendations of the Research Department of the Board has been forwarded to the Andhra Pradesh Government for necessary action. At the request of the Government of Orissa, the Agency areas of Orissa State reported to have suitable conditions of soil and climate for growing of coffee were visited by Sri. W. Raghavendra Rao, Senior Liaison Officer of this Department, during May 1959. The report is under preparation. The opening of pilot projects of coffee in 4 centres in the North Kanara District, suggested by the Mysore Government and technically approved by this Department, is pending execution.

6. Nominees of State Governments of Bombay, Assam and West Bengal were trained at the Coffee Research Station in the methods of coffee cultivation.

7. Dr. B. T. Narayanan toured the Liaison areas of Mysore, Coorg, Shevaroys, Nilgiris, Wynaad, Pulneys and South Kerala and met planters, both big and small, individually and in groups. Problems of individual planters as well as zonal problems were discussed. Special attention was directed to make the planters 'quality-conscious'.

8. The project to set up Regional Field Stations in the several Liaison Districts, which would serve as demonstration-*cum*-experimental centres for finding out solutions to the local problems, took concrete shape in the districts of Saklespur, Gonicoppal (South Coorg) and Kalpetta (Wynaad). Suitable sites for locating them were selected and plots acquired by negotiations. A phased programme of planting the entire area in two years (1959 and 1960) is under execution. A programme of construction of the requisite buildings for the office, store, staff and mazdoors has been drawn up and is being implemented. Scouting for suitable sites for locating such stations at Pulneys and Shevaroys during the 1959–60 season is in progress.

Development Plan

9. The scheme for collection and distribution of seeds of Station selections, setting up of co-operative pulping units and the accelerated programme of demonstration of improved techniques of coffee culture came within the purview of the Research Department. A brief review of the salient features of work done is presented below.

Collection and Distribution of Seed Coffee

10. A total of 9,305 lb. of seed coffee was procured from the two Research Stations at Balehonnur and Chethalli and 8 registered seed plots located in private estates in the Chikmagalur, Mudigere, North Coorg and Nilgiris Liaison Districts. The Liaison Officers arranged the distribution of seed to planters in their jurisdictions. 8,906 lb. of seed coffee was thus distributed to 2,205 planters during the year under report as against a distribution of 14,332 lb. to 2,529 growers during

the 1957–58 season. The yearly distribution of seed coffee from the year 1948–49 to 1958–59 and the number of planters who received the seed are given in Appendices II and III.

Establishment of Co-operative Pulping Units

11. The details of terms of assistance both technical and financial that are to be offered to the co-operative pulping units and individual pulping units under the provisions of Scheme V of the Development Plan were finalised. They are (1) all technical help for the lay-out of the units to be offered on request, (2) pulping equipment and machinery to be supplied on Hire-purchase system, (3) in the case of co-operative units, financial aid in the shape of purchase of shares or grant of interest-free loans. Taking advantage of the revised scheme of aids offered, the two units at Mallandur and Hosallypet in the Chikmagalur Liaison District started during the earlier years, stabilised their activities. Pulping operations were continued at these centres during the 1958–59 season and 1,439 bushels and 3,142 bushels of fruits were converted into parchment at the Mallandur and Hosallypet units respectively. In addition, four more units were organised during the year under report—one in the Chikmagalur, two in the Saklespur and one in the Kalpetta Liaison Districts. A total quantity of 6,159 bushels of fruit was converted into parchment at these four units during the 1958–59 pulping season. Supply of pulper on Hire-purchase basis was made to an individual planter in the Somwarpet (North Coorg) Liaison District who converted 1,600 bushels of fruit into parchment during 1958–59.

12. The one distinguishing feature noticed as a result of the activity of these pulping units was that a large section of the small-scale planter group have now become 'parchments-conscious'. It is estimated that as many as 50 new pulpers have been established during the last season by this section of planters.

Demonstration of Improved Techniques of Coffee Cultivation

13. As against a total of 317 demonstration and other trials at the end of the year 1957–58, the total at the end of the year under report stood at 334. A list of plots in the several Liaison Districts is furnished in Appendix IV. In addition, 194 estates which have received grants in aid under the Development Plan were under an intensive cultural programme according to a calendar of operations issued by the Department to suit individual estates. The upward trend noticed in the earlier years in the yields of these demonstration plots which are being managed according to advice offered by the Department was maintained during the 1958–59 season also. Many small planters in the neighbourhood are, of their own volition, copying the recommended practices in their holdings. The following speaks for the intense activity of the advisory services in various Liaison Districts:—

Number of demonstrations held	317
Number of group gatherings addressed	135

Number of follow-up visits paid to loan-aided estates ..	334
Advisory notes issued ..	15,000
Number of request calls attended to ..	7,500

14. A Field Day was held at the Coffee Research Sub-station, Chethalli, during December 1958 to bring the planting community in closer contact with Research Department. The day was well attended and the discussions at the forums were interesting and instructive.

15. A brief review of work done in the several Liaison Divisions is presented below.—

North Mysore Liaison Division

16. Sri. B. K. Chandrappa continued to be incharge of this division comprising of the Liaison Districts of Chikmagalur, Mudigere and Saklespur.

17. Intensive survey and critical investigations regarding the causes, the period of incidence, the extent of spread of the 'Kondlie' disease, were undertaken on a project basis in this Liaison Division in co-operation with the Plant Pathologist and the Botanist. Pending investigations in the laboratory, first-aid measures have been suggested and widely adopted by the planters.

18. The problem of the 'Hairy caterpillar pest' on the Giris was tackled. Control measures to keep the pest under check by spraying with D.D.T. 50%, Folidol E. 605 and setting up of light traps were advocated.

19. The peculiar problem of die-back of shoots reported from a number of estates in the Saklespur Liaison District was investigated.

20. In addition to stabilising the activities of the two co-operative pulping units started during the earlier year, 3 new units were organised in this division during the year under report. The activities of these units have been very encouraging and effectively made many small-scale planters parchment-minded.

21. Efforts to set up a Field Regional Station at Saklespur were actively pursued. The acquisition of the selected site was completed. Plans and programmes for planting up the area in the next two seasons were drawn up and are under implementation. The construction of a well, water storage reservoir and a temporary storage shed was completed. The construction of the necessary buildings at the Station is under way.

Chikmagalur District

22. Sri. K. R. Ahobala Rao, Liaison Assistant, was placed incharge of the current duties of the Office of the Junior Liaison Officer from 21–7–1958 till 22–12–1958. Sri. H. S. Puttuswamy, Junior Liaison Officer, rejoined duty on 23–12–1959 and was incharge of the district throughout the rest of the period under report.

23. A prolonged drought extending over nearly 5 months was experienced in the Giris. Blossom showers in sufficient quantities were received in the first and third weeks of April 1959 over the whole area excepting a patch of about 500 to 600 acres in and around Bynecool estate in the Eastern Giris. The South-West Monsoon was very heavy and continuous on account of which berry shed to an extent of 10 to 25 per cent. has been noticed. The crop position for the coming year on the whole is satisfactory and a crop of 6,000 tons is estimated.

24. The long dry weather conditions was chiefly responsible for a greater incidence of the White Stem-borer in the Eastern Giris. Sporadic, severe outbreaks of green bug were observed in the Upper and Western Giris in many estates. The pest was kept under check by timely application of control measures. The heavy and continuous monsoon also helped to a great extent to control the pest since the entomogenous fungi were very active during June and July 1959. Sporadic outbreaks of hairy caterpillar pest in and around Mallandur was promptly controlled by adopting timely control measures. Control measures against collar rot which assumed serious proportion in a few estates were undertaken. Leaf disease incidence has been very mild during the year. The incidence of 'Kondlie' has been very negligible.

25. There are at present 42 demonstration and other trial plots in this Liaison District. Thirty-four estates which received aids under the Development Plan in this district came under the close purview of the Department for carrying out a calendar of operations suited to the conditions of each of these holdings.

26. The two co-operative pulping units at Mallandur and Hosallypet continued to function during the year under report and pulped 1,439 and 3,142 bushels of fruit respectively enlisting a large participation by small-scale planters. A third co-operative pulping unit was organized at Hospur near Bagneheddal, and this unit converted 1,439 bushels of ripe fruit into parchment during the first year of its working. The institution of these co-operative pulping units has evinced great interest in the section of small peasant farmers and it is gathered that 20 new pulpers have been installed during the year under report by individual planters in the neighbourhood.

27. The Liaison Officer was on tour for 220 days visiting 284 estates and contacted 396 planters. Thirty-six group gatherings of planters were addressed. Over 148 advisory letters were issued. Fifty-four demonstrations were conducted during the year under report. 775 lb. of seed of Station Selections were distributed to 152 planters.

Mudigere Liaison District

28. Sri. K. T. Bhagat continued to be in charge of the district till 3–6–1959 on which date he proceeded on earned leave. Sri. K. R. Ahobala Rao, Liaison Assistant, was placed in current charge of this district during the absence on leave

of Sri. Bhagat, till 17–7–1959 when he was promoted to the post of Junior Liaison Officer and held charge of the district up to the end of the period under report.

29. Rainfall of 30 to 50 per cent. more than the normal received during June to August 1958 caused heavy shed of berries. Incidence of black-rot was heavy. Very heavy incidence of leaf disease was noticed during the post-monsoon period of 1958. A very long drought period commencing from the middle of November 1958 to the beginning of April 1959 was experienced. Blossom showers were mostly received during the first fortnight of April 1959, the amounts varying from 1 inch to 5 inches, resulting in a uniform and successful blossom in a major portion of the area under coffee in this district. The crop has been estimated at 3,600 tons over an area of 21,000 acres. The South-West Monsoon set in during the second fortnight of June 1959. The rains have been very heavy and continuous resulting in 15 to 30 per cent. more precipitation throughout the zone. The unfavourable weather conditions have occasioned the decrease in the estimates on the blossom by 10 to 15 per cent.

30. Heavy leaf disease incidence resulting in die-back and crop losses was observed during the year under report. The incidence of black-rot was also severe and prompt control measure has kept it largely under check. Very heavy incidence of 'Kondlie' resulting in loss of seedlings has been reported from many estates. First-aid measures of control were recommended to the concerned estates. Cercospora incidence in the nurseries was also on the increase and this was kept under check by prompt control measures. White Stem-borer pest of arabica was observed to occur on a very negligible scale during the year under report. Mild incidence of shot hole borer was reported in a few localised patches and control measures advocated. Red-borer activity on a mild scale occurred in a few estates in the 'Gonebid' sub-zone. Timely control measures brought the pest under check.

31. A quantity of 1,108 lb. seed coffee was distributed to 349 growers during the year under report. The performance of Station Selections has been very encouraging. They were noticed to be very hardy and withstood the adverse soil and climatic conditions admirably well and tended to over-crop in the early stages. Paddying on account of late and insufficient blossom showers was very negligible as compared to Kents.

Twenty-eight demonstration and reorientation plots and 20 differential manurial, field manurial, varietal and plant protection trials continued to progress. Thirty-five estates which received financial aids under the Board's Development Plan were intensively cultivated according to a calendar of operations issued to each estate.

32. The Junior Liaison Officer was on tour for 207 days visiting 400 estates and contacted 450 planters individually and in groups. Twenty-five group gatherings were addressed to emphasise the need to institute timely control measures against pests and diseases; 30 demonstrations were conducted during the period in

which scientific methods of manuring, spraying, shade regulation, soil and moisture control formed the main features.

33. The Department participated in an exhibition organised by the local Cattle Show and Exhibition Committees. The stall put up in this connection was visited by over 400 planters who evinced great interest in the charts and other exhibits displayed there.

Saklespur Liaison District

34. Sri. B. K. Chandrappa, Senior Liaison Officer, was in direct charge of this district in addition to his duties as Senior Liaison Officer of the North Mysore Liaison Division till 16–7–1959, when Sri. K. Haridas Menon who was posted as Junior Liaison Officer took over charge and continued to hold charge for the rest of the period under report.

35. Inadequate blossom showers during March-April 1958 resulted in an uneven development of the berries. Berry shed causing a loss of 15 per cent of crop was noticed during July–August 1958. The intermittent bright weather and showery period prevailing through the months of August to October encouraged a heavy incidence of leaf disease. Unexpected rains during November 1958 caused dropping of the ripe fruit. As a result, estates had to cure a greater percentage of their crop as cherry. The development of spike and new flush during pre- and post-monsoon season of 1958 was very good, forecasting the prospects of a bumper crop for 1959–60. However, the erratic, insufficient and untimely blossom showers coupled with long and severe drought conditions which prevailed over a period of 4½ to 5 months negatived this hope. This year's crop estimates have been placed at 2,000 tons on an area of 20,000 acres.

36. The incidence of White Stem-borer has been very negligible. Excepting for some sporadic incidence in patches, green bug incidence was very low. Leaf disease was observed on a severe scale during the post-monsoon season of 1958 causing die-back and a 10 per cent. crop loss. Nutritional-*cum*-plant protection measures were recommended and adopted by many estates. A peculiar kind of die-back of shoots was reported from a number of estates in the post-blossom season (May) of 1959. A survey was undertaken to determine the cause for this trouble.

37. 912 lb. seeds of Station Selections were distributed to 178 planters in this Liaison District during the period under report. Critical observation on the performance of Station Selections indicated that in spite of the unfavourable weather conditions, set and development as also yields in the Station Selections were comparatively better than in the leaf disease susceptible varieties. With a little precaution taken, the selections have withstood the long drought conditions of the early 1959 season better than other types of coffee. The percentage of CT among the Station Selections was more than in Kents.

38. Forty four Demonstration, Reorientation and other trials, laid out previously, were continued. A calendar of operations suited to the individual conditions was issued to 48 estates, which received monetary aids under the Board's Development Plan. Follow-up visits were paid to all the loan-aid estates periodically to check up progress against programmes given.

39. Two co-operative pulping units—one at Hadige in the Hanbal Sub-Zone and one at Tolalu in the Belur-Biccode Sub-Zone—were started during the 1958–59 pulping season taking advantage of the technical and financial assistance offered by the Department. 2,500 bushels of fruit were converted into parchment at Hadige during the season. There are signs of a greater number of planters participation in the coming years.

40. The acquisition of land for locating the Regional Field Station at Saklespur was completed by November 1958. Nurseries to provide seedlings for planting 6 acres during September 1959 and 7 acres during July 1960 were raised. Jungle clearing, pitting and other operations preliminary to planting in 6 acres have been completed. The construction of a well, water reservoir and temporary store-house was undertaken. The construction of a labour line is under way.

41. The Senior Liaison Officer was on tour for 234 days during the period under report, visiting 280 estates and contacted 400 planters. The tempo of advisory work was on the increase. 357 advisory letters to planters were issued. As many as 80 request calls were attended to.

Koppa Liaison District

42. Sri. W. Raghavendra Rao, Senior Liaison Officer (Development) at Headquarters Research Station, held direct charge of the Koppa Liaison District in addition to his duties.

43. The seasonal conditions experienced during July to September 1958 were satisfactory for the development of both arabica and robusta. Practically very little shedding of berries was noticed. The showery weather continued till the end of the first fortnight of November 1958. This helped in the production of very good flush especially in robusta. The drought conditions extending over nearly 5 months from November to April 1959 caused a serious setback. Robusta in many estates was badly parched resulting in the death of shoots and loss of cropping wood. Blossom showers which generally were received during the second fortnight of April 1959, were in many places uneven, insufficient and erratic. The spike 'paddied' to an extent of 15 to 30 per cent. in the older coffees. Estates which had set up rainers were able to save the situation to some extent by sprinkle irrigating the areas. The South-West Monsoon during 1959 started early in June. These precipitations were heavy and continuous and rain 25 to 30 per cent. more than the normal have been received. These unfavourable weather conditions have added further to the trouble already existing by way of a poor crop on the bushes by inducing a heavy shedding of berries. Prospects of crop for the year

1959–60 were not bright especially as regards robusta. A crop of 1,200 tons has been forecast over an area of nearly 16,000 acres of which 10,000 acres is under robusta.

44. The incidence of White Stem-borer has been negligible in all estates where control measures were scrupulously carried out. Black-rot was heavy in certain estates and necessary control measures have been advocated. Leaf disease occurred on a severe scale during the post-monsoon season of 1958. Preventive measures of control and proper nutrition of plants were suggested. Shot-hole borer of robusta was observed to occur on a very low scale. The nursery and post-nursery diseases were below pest level and suitable control measures were demonstrated and adopted wherever they were noticed.

45. 957 lb. seed of Station Selections were distributed to 133 growers during the 1958–59 season. Six reorientation spacing trials in robusta were laid out. Grafting demonstrations were conducted in two estates. A calendar of operations was issued to one loan-aided estate. Twenty request visits were made to estates and over 50 advisory notes in person and by post were issued.

South Mysore Liaison Division

46. Sri. G. I. D'Souza, Senior Liaison Officer, continued to hold charge of the South Mysore Liaison Division comprising of the Liaison Districts of North Coorg (Somwarpet), South Coorg (Gonicoppal) and North Kerala (Kalpetta-Malabar-Wynaad).

47. The presence of eelworm with the attendant economic losses has been detected and established in 3 big estates. Suitable steps of a quarantine nature to prevent the dispersal of the pest have been advocated. Destruction of the infested material to ensure sanitation and replanting with robnsta which is tolerant to eelworm have heen suggested.

48. Stray instances of 'Kondlie' in the freshly planted clearings of less than 3 years of age were inspected. Pending detailed examination by the Plant Pathologist, precautionery first-aid measures embodying the proper maintenance of nurseries and careful screening and rejection of the suspected material for planting have been advised.

49. A critical study of the field performance of Station Selections which occupy nearly 35 per cent. of the plant population under arabica in this division revealed the following main features:—

(i) The general performance like the vigour and hardiness of the material and its resilience to withstand adverse seasonal conditions was very good.

(ii) Shanking of berries was much lower when compared to the leaf disease susceptible material like Coorgs and Kents arabica.

(iii) They continue to put forth new vegetative growth even during the late North-East Monsoon period.

(iv) Rainy and cold weather during crop ripening does not cause as much of splitting, rotting of seedcoat and dislodging of beans as in Kents and Coorgs varieties.

(v) Curing analysis reports of S. 288 and S. 795 from a wide cross-section of estates have again indicated a greater percentage of triage when compared to Kents and Coorgs arabica.

(vi) 'Paddying' on account of late and insufficient blossom showers in selections were definitely lower than in the older material.

50. Periodical inspections of the regularly established seed blocks were made.

51. The Madakkimala Multi-Purpose Co-operative Society at Madakkimalai (Malabar-Wynaad) organized a co-operative pulping unit as a wing of its extension activities with the technical help offered by the Department. A double disc pulper was issued on Hire-purchase system to a planter in North Coorg Liaison District to establish an individual pulping unit.

52. The highlight of activity in this Liaison Division is the opening up of Regional Field Stations at Gonicoppal and Kalpetta. Acquisition of the selected sites was completed. Nurseries to provide seedlings for taking up planting during 1959 and 1960 were raised. The construction of necessary buildings is under progress.

North Coorg Liaison District, Somwarpet

53. Sri. G. I. D'Souza was in direct charge of this Liaison District up to 20–7–1959 when Sri. P. K. Ramachandran reported for duty as Junior Liaison Officer and continued to be in-charge of the District throughout the rest of the period under report.

54. The total rainfall recorded during the period under report was above average in all places. The rainfall recorded at Somwarpet amounted to 114·08 inches in 110 rainy days as against a precipitation of 103·51 inches in 124 rainy days during the previous year.

55. The bulk of the rainfall occurred between June and November 1958. Dry period which set in December 1958 continued till the end of April 1959. Scanty and belated showers received in April 1959 were not adequate to bring out a uniform blossom. Regular blossom showers over the major portion was received only in May followed by adequate backing showers in the same month. The delayed and insufficient blossom showers caused crop losses of 10 to 15 per cent. due to 'paddying' and burning of the spike. Crop estimates for the year 1959–60 are placed at 6,850 tonnes of arabica and 670 tonnes of robusta.

56. The advanced crop husbandry practised in general in this Liaison District inclusive of timely adoption of plant protection measures kept all insects and

diseases well below the pest level. Leaf disease and eelworm on a severe scale, White Stem-borer, Green Bug, Red Borer, Collar Rot, Kondlie and Black Rot on a mild scale occurred in this Liaison District during the year.

57. Six new demonstration and reorientation plots were added during the period under report making the total number of such plots and other trials to 28. Twenty-eight loan-aided estates in this District were intensively working according to a schedule of cultivation practices prescribed by the Department.

58. Ninety-three bushels of seed coffee from 5 Regional Seed Plots located in this Liaison District were procured during the 1958–59 season. A total of 930 lb. of seed coffee was issued to 329 planters during the year.

59. Grafting demonstrations of arabica scion on robusta stock were conducted in 3 estates during June–July 1959. Follow-up visits were paid to ensure maximum success of establishment by adequate after-care and proper training of the grafts.

60. The Liaison Officer was on tour for 233 days, visiting 370 estates and contacted 620 planters. Four group gatherings of planters were addressed and 25 demonstrations held. 124 request calls were attended to.

South Coorg Liaison District (*Gonicoppal*)

61. Sri. R. Vijaendraswamy, Junior Liaison Officer, continued to be in charge of the South Coorg Liaison District excepting for a period of 19 days in August 1958 when he was on earned leave.

62. A crop of 8,650 tonnes made up of 2,080 tonnes of arabica and 5,570 tonnes of robusta was harvested during the 1957–58 season. The condition of coffee up to the beginning of November 1958 was very good due to very favourable rain. The succeeding long hot weather extending over nearly 4½ months caused a set-back. Robusta in many estates was badly parched. The dry weather leaf shed of arabica was heavy. Substantial blossom showers that occurred late in March 1959 and during April 1959 followed by ample backing showers during May 1959, however, retrieved the position to a great extent. The monsoon started in the second fortnight of June 1959. Heavy precipitation causing water-logged conditions were experienced. Berry shed was found to occur to an extent of 10 per cent.

63. The incidence of leaf disease was low wherever timely plant protection measures were undertaken. White Stem-borer incidence was also very low. Severe incidence of Kondlie was reported from a few estates. First-aid measures have been suggested.

64. 934 lb. of seed coffee of Station Selections were distributed to 408 growers during the year under report. Critical observations on the performance of Station Selections indicated that they bore heavy crops of 6 to 10 cwt. on 4 and 5-year old clearings. Berry shed among the Station Selections was of a very low order. Leaf disease occurred to an extent of 16 per cent.

65. In connection with the Quality Testing Scheme, 5 tons each of S. 795 and S. 288 were prepared under departmental supervision.

66. At the close of the period under report, there were in operation 33 demonstration, reorientation and other trials in this Liaison District. The upward tendency in cropping was continued to be maintained in all these plots.

67. The Liaison Officer was on tour for 142 days and visited 194 estates and contacted 144 planters. Over 1,654 advisory notes were issued and 98 request calls were attended to.

68. The main activity was the establishment of the Regional Field Station. A plot of 26 acres of land (Government Poromboke) was allotted by the Government of Mysore to Coffee Board for starting the Station. Nurseries to raise sufficient seedlings for planting 6 acres during the current season and another 8 acres during the coming year were prepared. Jungle-felling and clearing of 13 acres was undertaken. A well and a water reservoir have been constructed. The construction of buildings to locate the office and house the staff is programmed to be taken up in 1960–61.

Kalpetta Liaison District (Malabar-Wynaad)

69. Sri. H. Hanumantha Rao, Junior Liaison Officer, was in charge of the Kalpetta Liaison District comprising of the coffee areas in North Kerala in the taluks of South and North Wynaad.

70. The rainfall during the year was 50 to 60 inches more than the decennial average for this Liaison District. The 1958–59 crop of 5,500 tons in this district was an all-time record. This represents a steady increase from about 3,000 tons in 1952–53.

71. The prolonged drought beginning from December 1958 up to the end of March 1959 resulted in a severe parched-up appearance of coffee. In many estates, it looked as though a fire had run through the estate. Satisfactory blossom showers were received during April 1959. However, heavy downpours on the opening day of the blossom seems to have affected a satisfactory set. Backing showers amounting to 6 to 8 inches were received in May 1959. The South-West Monsoon started during June 1959. Unprecedented heavy rains were received during July 1959. These excessive rains, which are conducive to wet-feet of coffee have caused appreciable berry shed. The spike estimate of 6,000 tons of crop for the year 1959–60 have been scaled down to 4,000 tons on account of these adverse seasonal conditions.

72. No serious outbreaks of pests and diseases were noticed during the year. The incidence of shot-hole borer was below pest level on account of the lower carry-over and undertaking of timely control measures. Mild occurrence of collar rot and Cercospora were kept under check by the institution of control measures. A stray instance of eelworm trouble was observed in Cottanad Estate. Treatment with bulky organic manures has helped the plants to resist the pest.

73. 659 lb. of seeds of Station Selections were distributed to 147 planters in this Liaison District during the year of reporting. Observation regarding the performance of Station Selections planted in the earlier years indicated that the yield levels varied from 6 to 19 cwt. to an acre on 3 to 4-year old plants.

74. There are at present 35 demonstration and reorientation plots as against 28 such trials at the end of the preceding year. Eleven field manurial, varietal and plant protection trials were continued. The yield levels in the demonstration blocks have been stepped up to an average of 5 cwt. level from the pre-demonstration $\frac{1}{2}$ to 2 cwt. status. The yields in the reorientation plots have gone up to 9 to 14 cwt. to the acre. Two estates which have received grants-in-aid under the Board's development plan came under the very close purview of the Department's advisory services. 119 applications for loans-aid from planters were investigated during the period January to July 1959.

75. A pilot co-operative pulping unit in this mainly robusta area was started under the aegis of the Madakkimala Co-operative Credit Society. Technical help, supply of pulper on Hire-purchase system and an interest-free loan of Rs. 2,000 have been offered to the above society.

76. A plot of 20 acres of forest land belonging to Messrs. Kottaram Plantations was finally selected and acquired for opening the Regional Field Station in this Liaison District at Kalpetta. Nurseries were raised from January 1959 to provide sufficient seedlings for planting 6 acres during September 1959 and another 8 acres during 1960. The area proposed to be planted during 1959 was fenced. Jungle clearing, line marking, pitting and filling up pits were completed. Construction of a well was finished. Construction of a labour line and water reservoir has been taken up.

77. The Junior Laison Officer toured for 252 days visiting 370 estates and meeting 667 planters. He addressed 11 planters gathering and conducted 44 demonstrations on cultivation practices.

Coimbatore Liaison Division

78. Sri. T. V. Pattabhiraman, Senior Liaison Officer, continued to be in charge of the Coimbatore Liaison Division. The division comprised of the Annamalais, Nelliampathies, Tirunelveli-Kanyakumari Zones which came under the direct charge of the Senior Liaison Officer and the Liaison Districts of Pulneys and Nilgiris under his supervisory charge. The newly created Liaison District with its Headquarters at Kottayam to cater to the needs of the South Kerala planters was attached to the supervisory charge of the Coimbatore Liaison Division with effect from 16–4–1959.

79. The Senior Liaison Officer toured 165 days visting 237 estates and contacted 466 planters. Seventeen group gatherings of planters were addressed in which local cultivation practices, manuring, plant protection measures, etc., were held.

80. As a result of intense propaganda, the general standard of working in many of the estates in this division has been considerably stepped up. Estates which have scrupulously followed the departmental recommendations have been able to increase their yields to a level of over 8 cwt. to an acre as against a standard of 1 to 3 cwt. previously.

81. Investigations into the 'Berry Blotch' disease caused by *Colletotrichum coffeanum* and the leaf miner pest (*Agromyza coffeæ*) were undertaken. A survey of other pests and diseases of coffee in these areas has indicated that their prevalence during the year under report has been negligible wherever the incidence was reported. Planters were advised promptly of the control measures to be undertaken.

82. The area under Station Selections in this division is estimated at 2,000 acres. Most of the plantings are less than 4 years old and have just come to bearing —only in a few estates—with an estimated crop of 4 cwt. to an acre. Incidence of Black-rot, Cercospora, 'Berry Blotch' has been commonly noticed in all the unsprayed clearings of the Station Selections. 834 lb. of seed coffee were distributed to 17 planters by the Senior Liaison Officer.

Pulneys Liaison District (*Dindigul*)

83. Sri. S. J. Mathias continued to hold charge of this Liaison District. He was assisted up to the end of the period under report by Sri. P. K. Ramachandran, Liaison Assistant.

84. The coffee crop during the year 1958–59 was very poor on account of bumper harvests in 1957–58. The flush growth during the pre-monsoon and post-monsoon seasons of 1958 was very vigorous. The dry weather of 1958–59 season helped profuse spiking. Blossom showers, though generally substantial in a few places, were erratic in a major portion of the area. However, a record crop of 3,500 tons for the year 1959–60 has been forecast.

85. Leaf disease occurred in a mild form. It is estimated that over 70 per cent. of planters in this area have taken up to spraying. White Stem-borer incidence was below 0·6 per cent. wherever the control measures had been scrupulously carried out. A stray attack of the berry borer pest was effectively controlled by a spray with Folidol E 605 at 2 oz. in 40 gallons of water. Green bug was noticed to occur on a severe scale causing crop losses upto 3 per cent. Insecticidal sprays to control the pest have been suggested and widely adopted.

86. As against 2 demonstration and other trials during 1957–58, there are at present 27 such trials. The results obtained in the demonstration and reorientation plots have been very encouraging, in that many small-scale and medium-scale planters in the neighbourhood have taken up to the recommended calendar of operations of their own volition. A calendar suited to the individual conditions has been issued to 12 estates to which monetary aids under the Board's Development Plan have been sanctioned.

87. The Liaison Officer was on tour for 178 days. 220 estates were visited and 543 planters contacted. 26 group meetings of planters were addressed. 24 demonstrations were held on the improved cultivation techniques advocated by the Department. The steady increase in crop from 2,200 tons in 1954 to 3,500 tons (estimated) in 1959–60 represents in a measure the intensity of propaganda carried out by the advisory service.

88. 956 lb. of seeds of Station Selections were distributed to 188 planters during the year under report. Scouting for suitable plots for locating the Regional Field Station was undertaken. A request made to the Forest Department authorities for the grant of 25 acres of land in the Kodavanar Reserve is still pending.

Nilgiris Liaison District (Coonoor)

89. Consequent on the creation of a new and separate Liaison District for the Nilgiris (inclusive of Nilgiris-Wynaad), Sri. K. C. Ananth took over charge of this post from 14–6–1958. The Headquarters of the District was at Coimbatore in the beginning and shifted to Coonoor from 20–8–1959. Sri. K. C. Ananth held charge of the district throughout the period. He was on earned leave from 20–10–1958 to 8–11–1958, 9–12–1958 to 28–1–1959 and from 17–5–1959 to 16–6–1959. During the leave periods, Sri. T. V. Pattabhiraman, Senior Liaison Officer, held additional charge of this district.

90. A rainfall of 60 to 75 inches was received during the period April 1958 to the end of March 1959. The weather was comparatively dry from January to the end of March 1959. Blossom showers were received during the first week of April 1959. Gudalur area experienced dry weather from November 1958 onwards till April 1959. The blossom showers, however, were adequate to bring out a uniform and successful blossoming.

91. A severe attack of leaf disease was observed in estates which have not taken up spraying operations. Green bug was below pest level. White Stem-borer was severe especially in young clearings and suitable control measures have been advocated. Shot-hole borer on robusta was in evidence in a severe form in the Gudalur area.

92. Nineteen demonstration and reorientation plots, 8 differential manurial, field manurial and varietal trials were in progress. Twenty-seven applications for loans-aid were investigated into. The Liaison Officer toured for 152 days, visiting 154 estates and contacted 212 planters. 433 lb. seed of Station Selections were distributed to 54 planters. A quantity of 5 bushels seed coffee was procured from the Regional Seed Plot at Glenvans Estate.

93. The incessant and intensive propaganda carried out by the Liaison Service to combat leaf disease has made many estate owners 'spray-minded'. From a small acreage of a hundred acres in 1955, the total area that is sprayed at present is estimated at 6,500 acres.

South Kerala Liaison District (Kottayam)

94. Sri. K. Haridas Menon, Liaison Assistant, attached to the Office of the Junior Liaison Officer, Kalpetta, was deputed to undertake an intensive survey of the coffee areas in South Kerala early in October 1958 to collect statistics on coffee cultivation and to list the coffee problems. *Inter-alia*, a study of the performance of Station Selections being grown in the localities during the previous three seasons was also made. A separate Liaison District to cater to the needs of the nearly 16,000 acres of coffee in this area was formally established in December 1958. Sri. K. Haridas Menon held charge of this District from December 1958 to 15–4–1959. Sri. C. K. Ponnappa, Junior Liaison Officer, who took over from Sri. Haridas Menon held charge of the district from 16–4–1959.

95. A major portion of the area under coffee in this tract is robusta and confined to back-yard holdings. Coffee is cropped mixed with arecanut, pepper and tapioca. Practically no fertilizers are applied. The rehabilitation of coffee in these peculiar circumstances calls for a concentrated propaganda drive on the part of the advisory services to bring home the advantages that would be derived by adopting improved scientific methods of coffee culture.

96. It is however interesting to observe that in spite of the aforesaid conditions and in the absence of the required care and attention, Station Selections have been found to grow very vigorously. These have been planted at elevations below 500 ft. m.s.l. also. It is at the same time too early to forecast the yielding potential of this material at present though the plants appear to suffer no distress.

97. With the very favourable weather conditions experienced during the 1958 season, good crops have been harvested. The crop pooled during 1958–59 season has been the highest on record since 1953–54. Early blossom showers were received during February 1959. The tract experienced a very long drought season during the summer of 1959. The rains during the South-West Monsoon period which commenced in June 1959 have been very heavy.

98. The Liaison Officer was on tour for 33 days and visited 88 estates and met 250 planters. Forty advisory notes were issued. Six group gatherings of planters were addressed. A quantity of 653 lb. seed coffee of Station Selections was distributed to 193 planters.

99. An area of 1,000 acres of coffee has adopted intensive cultivation measures inclusive of manuring, and plant protection operations as a result of advisory activities. An increase of 300 tons in the off-take of fertilizers in this district may well be ascribed to the encouraging response by the planting community to the departmental advisory service by personal contacts and advisory notes.

Yercaud Liaison District

100. Sri. L. V. Vaidyanathan was in charge of the Liaison District from 1–8–1958 to 4–10–1958 and from 8–11–1958 to 31–1–1959. Sri. P. K. Ramachandran, Liaison Assistant, was in charge of the duties of the Junior Liaison

Officer from 5–10–1958 to 7–11–1958 and again from 1–2–1959 to 1–5–1959. Sri. C. K. Vasudevan who was promoted to officiate as Junior Liaison Officer held charge of the post from 2–5–1959 and continued to be so at the end of the period under report. This Liaison District continued to be under the direct supervisory charge of the Director of Research.

101. A total of 46·57 inches of rain was received during the period as against 47·57 inches during the last year. An early blossom shower in January-February 1959 brought forth 10 to 25 per cent. blossom. Regular blossom showers were again received during April 1959 bringing forth a second wave of blossoms. The backing showers have been ample. The estimate for the 1959–60 crop season has been placed at 2,000 tons, which may be one of the record crops in the zone.

102. There has been a spurt in the incidence of White Stem-borer, the weather conditions being favourable for pest activity. The strict adoption of control measures is being impressed upon. Green bug was noticed on a wide scale, but kept under check effectively by timely spraying with parathion compounds. Leaf disease was severe in the early part of 1958, but was mild during the later periods.

103. A total of 39 demonstration, reorientation and other trial plots were under progress during the year under report. The yield levels in all the estates which have been worked according to the calendar of operations issued by the Department was 50 to 100 per cent. over the average yields of the previous 3 seasons. Spot inspections were done on 22 estates which applied for grants-in-aid under the Board's Development Plan. Four estates which received such aids are receiving intense attention of the Department's advisory staff.

104. 209 lb. of seed coffee of Station Selections was distributed during the 1958–59 season to 57 growers.

105. A plot of land belonging to the District Board and located at Yercaud has been selected as suitable for establishing the Regional Field Station for this district. An application filed before the concerned authorities for the grant of this land is pending issue of orders.

Senior Liaison Officer (Development) at Headquarters

106. Sri. W. Raghavendra Rao continued to be in charge of the post throughout the period covered by the report, except for the period from 28–7–1959 to 31–7–1959 when he was on earned leave.

107. He assisted the Director of Research in co-ordinating the work in the Liaison Districts, in the implementation of Schemes III, V and VI of the Development Plan (collection and distribution of seed coffee, establishment of co-operative and individual pulping units, execution of the accelerated programme of organising demonstration and other trials) which came under the purview of the Research Department for execution. Financial requirements were budgetted for and the funds properly deployed. The progress made under each of the schemes

was assessed periodically. The following are the results of the activities of this section :—

(i) *Collection and Distribution of Seed Coffee.*—A total quantity of 245 bushels of seed coffee was procured from 8 Regional Seed Plots located in private estates and the two Research Stations. Distribution of 8,906 lb. of seed coffee was undertaken from 12 distribution centres to planters. The demand for seed coffee is on the increase.

(ii) *Establishment of Co-operative Pulping Units.*—The activities of the two co-operative pulping units started during the earlier years were stabilised. In addition, four more units were organized during the 1958–59 season. The units have been very helpful in creating 'quality awareness' among many small-scale planters. Assistance by supply of a pulper on Hire-purchase system was given to a planter to establish an individual pulping unit.

(iii) As against 317 demonstration and other trial plots at the end of 1957–58 season the total of such trials existing at present is 334. Demonstration plots which have attained maturity and whose level of production have been stabilised at 5 cwt. of crop to the acre have been converted into non-subsidisable reorientation plots. Many planters in the neighbourhood of these demonstration plots have adopted the recommended calendar of operations in their holdings of their own accord.

108. The Senior Liaison Officer (Development) toured the Agency areas in Andhra Pradesh and Orissa States for judging their suitability for coffee cultivation.

N. G. CHOKKANNA,
Director of Research.

PART IV

A. SUMMARY OF RESEARCH

I. AGRONOMY

Agronomic trials started earlier on the influence of different cultural practices on yield of coffee, manuring of robusta with and without pruning, mulching and growing green manure and cover crops in young arabica coffee and its effect on the growth and yield were continued. Crop estimation studies and the growing of coffee by the Brazilian system as also experiments with growth-promoting chemicals initiated earlier were continued.

2. The experiments on soil cultivation practices laid out at the Coffee Research Station, Balehonnur, and at the Coffee Research Sub-station, Chethalli, were in progress. The results during the year were not statistically significant in both the localities; but the yield data recorded was highest in the trenching treatments and did not give any indication to choose between the two depths of trenching, *viz.*, $1\frac{1}{2}$ and $\frac{3}{4}$ ft.

3. On the other studies of soil management experiment at the Coffee Research Station, Balehonnur, the yield from the mean average of the past four years showed that light digging in November appeared to be the best.

4. The manurial trial laid out in the year 1951 to evaluate the response of varying levels of nitrogen, *i.e.*, 40 and 80 lb. keeping phosphorus and potash at constant levels, *i.e.*, 30 P and 40 K, were continued. The indications obtained for the successive two years are for 80 lb. of nitrogen application per acre.

5. The other two robusta manurial and pruning experiments at private estates also showed the same trend.

6. Mulching and mulch-*cum*-manurial trials to study the response on growth and yield on young arabica coffee were continued.

7. From the robusta topping experiment laid out at Byregudda Estate in the year 1951, the yield records were continued to be collected.

8. *Studies on Crop Estimation.*—During the year, crop estimation studies on the lines of 'Kenyan selective stripping', already reported in the previous report, were conducted at the two Research Stations and extended to 37 estates in the several Coffee Liaison Zones of South India. This pre-harvest technique of estimation appears to give reasonable estimates with a variation of 0·8 to 24·3 per cent. These trials will be continued for one or two seasons to standardise the method.

9. The long-term experiment on shade requirements of arabica coffee laid out in 1955–56 at Coffee Research Sub-station, Chethalli, was continued. The growth and yield data of different treatments were continued to be recorded.

10. The small-scale trials with growth-promoting substances on arabica coffee were pursued. The chemicals Nikota-S. 271 and Naphthalene acetic acid did not show any desired result.

II. BOTANY

11. The work on coffee breeding with reference to leaf disease resistance and high and even bearing qualities was continued. Pure line and cross-breeding, field trials of promising selections, comparative trials on clonal progeny of promising cultures, collection of foundation stock, both local and foreign, cytological studies and studies on triage of coffee were in progress.

12. Cultures of 5th Gen. of S. 26, 3rd Gen. of S. 31, S. 44, S. 72, S. 73, S. 178 and S. 179 and 2nd Gen. of S. 795 were under observation. These continued to show a high degree of resistance to leaf disease in the field. Selected plants in S. 795, S. 44 and their progeny were cross-bred with Ethiopian, Rume and Barbuk collections showing resistance to leaf disease in the field, Kents arabica selection from Tanganyika and with Padang and Philippinean having desirable bean characters.

13. Seventy-three intra-crosses between arabica cultures established from 1952 to 1958 were under study. Fifteen of these showed field resistance to leaf disease; 57 showed susceptibility up to 30 per cent. and 5 above 30 per cent. These latter have been discarded. The second yield from cultures planted in 1952 ranged from 3·9 to 7·5 cwt. to an acre.

14. Comparative trials with cultures of the B.A. series among arabica and B.R. series among robusta progressed. From the initial yields recorded so far, B.A. 11, 12, 13, 19, 20, 23, 16, 18 and 28 among arabica and B.R. 5, 6, 12, 10 and 14 among roubsta are leading the other cultures.

15. The range of susceptibility to leaf disease in the robusta × arabica hybrids and their back-crosses continued to be as in the previous year. These cultures produced float ranging from 2 to 21·7 per cent. and pea-berry from 12·8 to 80 per cent. False-polyembryony occurs as in Kents and Coorg arabica up to 5 per cent. The cultures are observed to respond to blossom showers of 48 cents and over. Paddying up to 20 per cent. has been noticed in a few plants.

16. Seed material from Seagahalli hybrids in Sulgode Estate and seedling material from hybrid plants in Kotada Estate, Nilgiris, were received and added on to the foundation stock.

17. The introductions of coffee plant material from outside countries comprise of 128 arabica, 4 of liberica, 10 of robusta, 2 of excelsa and 6 species of Coffea. In the arabica collections Geisha, Rume and Barbuk as well as up to 20 per cent. plants in Taffarikela and Kaffa continue to be free from leaf disease in the field.

18. Sample seeds of S. 795, S. 288, S. 333 arabica and S. 274 robusta were supplied for trial purposes to Philippines, Laos, Viet Nam, China and West Germany.

19. As in the previous years, treatment of single-noded leafy sucker cuttings of arabica with Seradix L. 15 gave 73·7 per cent. rooting as against 60 per cent. with Seradix L. 30, 42·2 per cent. with cow's urine extract and 31·2 per cent. in untreated control.

20. The technique of top working 2 to 3 month old sucker stocks on unstumped robusta with arabica sucker scion of similar age and stage of development was standardised, and is being used for large-scale grafting. Demonstrations in the technique were held in 16 estates in 7 Liaison Districts in Mysore and Kerala States.

21. Over a period of 8 years, there does not appear to be any difference in yields noticeable in the multiple stem system of raising arabica as against the traditional single stem system. In the case of robusta, due to heavy incidence of shot-hole borer, the yield from the multiple stem plots is 50 per cent. less than that from single-stem plots.

22·1. From one year's study of factors relating to triage production, it is seen that false-polyembryony (production of more than one ovule in the same locule) which results in bits and hollows, etc., of triage occurs in S. 288 and progeny from 28·3 to 48·3 per cent.; in S. 795 up to 18·9 per cent. and in Kents and Coorgs from 4·0 to 4·6 per cent. In the progeny of S. 795 it occurs from 8·9 to 13·1 per cent. True polyembryony (occurrence of more than one embryo in the same ovule) occurs from 0·15 to 0·31 per cent. in Kents, Coorgs, S. 288 and S. 795; similarly in all these, 3-bean (tri-locular) fruits, black and brown beans occur up to 1·6 per cent.

22·2. Malformed beans occur also from other causes which are not yet clear. This category forms the major portion of triage in Kents and Coorgs arabica. It is also not yet clear whether age, environmental conditions and nutritional factors influence the triage. In a very preliminary study on Kents arabica, it is seen there appears to be a trend that nitrogen feeding at certain stipulated periods helps in lowering or containing the triage.

23. In the varietal trial in progress at Chethalli, it is seen that on an aggregate of 8 years' yields, S. 795 has out-yielded S. 645, S. 288 and S. 446. The sharp decline in yield of S. 795, S. 645 and S. 288 during the year under report is attributed to the prolonged and delayed harvest of the previous heavy crop which adversely affected flower-bud initiation and development and also to seasonal conditions.

III. CHEMISTRY

24. Experiments on the manurial requirements of coffee, influence of trace elements on the growth and vigour, land management with special reference to soil and moisture conservation and studies on the processing of coffee were continued.

25. The manurial experiment to study the essential requirement of major plant foods either singly or in combination has completed 19 years. It is noticed from the yield data that nitrogen in combination with phosphorus produced consistently high yields and crop increase is commensurate with the increase in application of nitrogenous fertilizers.

26. Fundamental manurial experiments on the application of varying levels and combinations of N, P and K were continued as also trials on varying doses of nitrogen from 40 to 100 lb. to the acre with fixed levels of P and K, trials on different sources of nitrogen and varying doses of P and K with a fixed level of nitrogen. These trials bring out the relative importance of a balanced fertilizer application.

27. Observational trials on the effect of increasing doses of fertilizers and field trials to find out the optimum economic doses of nitrogen and the role of phosphates and potash in the utilization of nitrogen were continued. Trials to study the effect of fertilizer mixtures containing aldrin do not appear to have any beneficial effects.

28. Field manurial trials to study the application of different levels of nitrogen from 40 to 100 lb. with fixed levels of P and K on arabica and robusta were continued in different soil and climatic zones of coffee-growing areas. These show the importance of split doses of nitrogen with adequate quantities of phosphorus and potash.

29. Field trials on the effect of varying and fixed levels of N, P and K on the growth and yield of robusta coffee were continued. Yield records show that the yields are consistent at 60 : 45 : 60 level.

30. Field manurial trial to study the effect of chelated metal and trace elements on the yield and vigour of plants started last year was continued. Similar trials in pots under more controlled conditions were started during the year.

31. Studies on the uptake of plant nutrients in seedlings show that in initial stages nitrogen content of stalks is higher than in leaves in very young seedlings, whereas it is higher in leaves and lesser in stalks and roots when the plants get older. Organic carbon content in leaves is uniform while in stalks and roots it increases steadily as the plants grow older.

32. Studies on the foliar absorption of plant nutrients show that (1) absorption of plant nutrients is much quicker in young leaves than in old leaves. Young leaves absorb nutrients within 24 hours while in old leaves it continues even after 96 hours. Nutrient solutions of lower concentration (1%) are readily accepted by both young and old leaves, than concentrated solutions.

33. Samples of coffee received from Assam, West Bengal and Andhra Pradesh were cup tested for their quality. Out of the 18 samples from Assam, eight are above average quality and one about average.

IV. ENTOMOLOGY

34. Survey on the intensity of incidence of pests of coffee was in progress. Several new eelworm-infected localities were detected. Incidence of shot-hole borer in the general estate of Coffee Research Station for 1958–59 was 16·57 per cent. less than that of 1957–58. Mild infestations of red borer were detected at Bankal, Mudigere in early 1958–59. Independent tracing for red borer for the period July 1958 to June 1959 in the estate at the Coffee Research Station showed that the incidence reached a peak in May 1959 with N.M.S. V showing the maximum degree of incidence. The incidence per acre was 3·13. The incidence of hairy caterpillars was rather severe at Chikmagalur though timely adoption of control measures considerably limited the damage to coffee. Infestation of green bug was reported from various estates of North Coorg, Chikmagalur, Nilgiris, Shevaroys and Pulneys. Mealy bug incidence was observed in Kalpetta and Coorg areas. Natural control agencies and artificial control methods kept the species in check. Incidence of White Stem-borer did not cause much alarm.

Applied Research

35. Fresh trials have been started to control *White Stem-borer* with B.H.C., Dieldrin, and Gusathion under the auspices of the P.P.T. scheme. Trials with organophosphates on *green bug* control indicated that Gusathion at 0·05 per cent. possessed the longest duration in toxicity (25 days) while Folidol at 0·01 per cent. was equally effective only for 15 days after treatment. Laboratory trials on *mealy bug* showed that Basudin at 0·03 per cent. and 0·06 per cent. was consistently superior to other chemicals in 48 hours after treatment. In the field, Gusathion and Basudin were superior to Ekatin, Folidol and Fosferno. Spray trials with Meta-iso-systox and Ekatin on *shot-hole borer* brought forth promising results. Studies on the control of *hairy caterpillars* showed that Folidol or B.H.C. were the ideal insecticides to control the early instars on dadaps while D.D.T. or Dieldrex would be preferable on the late-migrating instars. Extended trials with Paramar, Fosferno, Gusathion and Malathion are contemplated. Trials with Nemagon on *eelworms* indicated that the chemical effected significant pest population reduction in the first six months following treatment. Extended trials with Nemagon, Soil Amendments, Farm-yard Manure, Vapam, V.C. 13 Nemacide are in progress at Wooligooly Estate, Coorg.

Basic Research

36. Several *insect parasites* of green bug, hairy caterpillars and leaf miner have been collected and identified. The *life-history* of the *hairy caterpillar*, *E. fabia*, has been worked out. Studies on *red borer* (life-history) are in progress. The distribution of various species of eelworms has been determined for 1958–59.

V. MYCOLOGY

37. Field trials on spraying of coffee to find out efficient and economic methods of control and to evaluate the efficacy of various proprietary fungicides

as compared to the standard Bordeaux mixture in controlling the major diseases of coffee and fundamental work on the life-history and possibilities of control of the common diseases were continued.

38. Results from comparative spray trials using various proprietary formulations continued to show the same trends as obtained in the previous year, *viz.*, none of the proprietary formulations tested have so far given a consistently significant superior control of leaf disease over that afforded by 0·5 per cent. Bordeaux mixture.

39. A number of field trials have been started both in the South-West and North-East Monsoon areas recently under the Proprietary Products Testing Scheme to evaluate various proprietary formulations. Observations recorded in the time of spray trials at Shevaroys indicate that three rounds of spray is better than two, one and no-spray treatments under North-East Monsoon conditions.

40. Two field trials have been started recently to find out whether there are any beneficial effects to be derived through spraying of leaf disease resistant selection material.

41. A spray trial has been recently started to find out whether spraying the upper surface of leaves alone could afford protection from leaf disease comparable to spraying on the under-surface. The practicability and effectiveness of a Low-Volume Spray through Micronette Sprayer is being studied.

42. A study of the symptomology and morphological characters of different culture isolates indicated the possibility of two different species of *Cercospora*, namely, *C. coffeicola* and *C. coffea* being responsible for Brown-eye-spot disease in South India. Effective control of the disease was brought about by routine spraying with Bordeaux mixture, Dithane M-22 and Flit-406.

43. For the past two years, heavy seedling losses due to a hitherto unknown malady have been noticed in certain coffee zones. The disease is found to be fairly widespread, being noticed in most of the coffee-growing areas of Mysore and Coorg. The disease symptoms become apparent in eight to eleven-month old seedlings either in the nursery or shortly after transplanting to field. The disease symptoms have been studied in detail. A certain amount of natural recovery of mildly affected seedlings is often observed. In the large majority of cases, *Chaetophoma* sp. and in a few cases *Fusarium* sp. and a bacterial culture have been isolated from malformed tissues. Attempts at artificial reproduction of the disease using the different micro-organisms found associated with diseased tissues have so far been unsuccessful. Studies so far made seem to indicate that frequent application of Bordeaux mixture either alone or in combination with fertilizers is correlated with a high incidence of the malady. Disease incidence to varying degrees was noticed on plants receiving different fungicidal treatments. It is interesting to note that disease incidence was either absent or very low in plots receiving no chemical spray or where Flit-406 was sprayed. In a trial to find out the varietal susceptibility to this disease, it was observed that while S. 333 and

Coorgs varieties showed the disease incidence, in the case of Kents variety only very mild symptoms have been observed.

44. Viability duration of spores of *Myrothecium advena* and relation of humidity levels to successful infections have been studied.

45. Drenching of germination beds with Bordeaux mixture has been found to cause failure of production of normal root system in germinating seedlings.

46. A new entomogenous fungus causing biological control of green bug of coffee and a new leaf-spot causing disease of arabica coffee have been recently recorded. These have been identified as *Hypocrella olivaceæ* and *Sarcopodium* sp. respectively.

B. DETAILED SECTION REPORTS

I. AGRONOMY

The main work of the Agronomy Section consisted of studies on the influence of several cultural and soil management practices on the yield of coffee, manurial trials with and without pruning on robusta coffee, and the effects on growth and yield of young arabica coffee by mulching and growing green manure and cover crops. Studies on the estimation of the crop, and growing of coffee by Brazilian system with suitable modifications were pursued. An observational trial was started in the main Station in 1958 with the object of rehabilitating old robusta plants for higher production.

Field Experiments

I. Studies on the Influence of Varying Soil Cultivation Practices on the Yield of Arabica Coffee

(*a*) *Soil Cultivation Experiment—Coffee Research Station, Balehonnur.*—This trial started in July 1954 on old arabica coffee was continued. Different methods of soil cultivation such as trenching, renovation pitting and light and deep digging are compared against control which is given weeding only. The yield data of the experiment are given in Appendix IX.

The yield differences during the four years the trial has been in progress are not significant. Trenching $1\frac{1}{2}$ feet (45·7 cm.) deep in the first year, renovation pitting in second year, trenching $\frac{3}{4}$ foot (22·9 cm.) deep in the third and fourth years have given numerically higher yields. Light digging in general accounted for the lowest yields. A study of the mean average yields for the past four years showed that trenching was numerically superior to renovation pitting or digging, but there was very little difference between the two depths of trenching. The yield in the case of clean coffee also showed a similar trend.

(*b*) *Soil Management Experiment—Coffee Research Station, Balehonnur.*—This experiment was started in July 1954 with the object of studying the effects of digging to two different depths, *viz.*, 6 and 3 inches (15·2 cm. and 7·6 cm.) in three

seasons of the year, *viz.*, May, August and November on the yield of coffee. The experimental plot received all other cultural operations in common with the general estate except the treatments. The yields of coffee, both cherry and clean, for the past four years are presented in Appendix X.

The treatment differences during the four years the trial has been in progress are not significant. Light digging in November in first year, weeding only in the second year and deep digging in November in the third year and deep digging in November and April in the fourth year accounted for the highest yields. A study of the mean average yields for the past four years showed that light digging in November appeared to be the best.

The experiment is being continued.

II. Manurial Experiment on Robusta—Coffee Research Station, Balehonnur

This manurial trial was laid out in the year 1951 with a view to study the effect on yields of varying levels of nitrogen with fixed applications of phosphorus and potash. The robusta trees are planted at a spacing of 8×8 feet ($2 \cdot 4 \times 2 \cdot 4$ metres) and are about 25 years old. Half the dose of nitrogen is applied during the pre-blossom and the other half, along with full quantity of phosphoric acid and potash, is applied in the post-monsoon period. The two levels of nitrogen under study are 40 and 80 lb. to an acre while the rates of phosphoric acid and potash are 30 and 40 lb. respectively.

The yield data of the experiment are furnished in Appendix XI. The results during the year are not significant. The yields for the seven years the trial has been in progress have not yielded any significant results. However, the plot receiving 80 lb. nitrogen has given numerically higher yields for the second year in succession followed by the plot receiving 40 lb. nitrogen.

The experiment is being continued.

III. Robusta Manurial and Pruning Experiments—Private Estates

Two experiments were laid out during 1952 in two private estates in the neighbourhood of the main Station, at Bhadra and Devadhanam, on the same lines as in the case of the experiment on robusta coffee at the Coffee Research Station, Balehonnur. These experiments were, however, further extended to study the influence of light pruning on the yields of coffee. The coffee bushes are of medium age, about 30 to 35 years and are planted at a spacing of 8×8 feet or $2 \cdot 4 \times 2 \cdot 4$ metres.

Two levels of nitrogen, *viz.*, 40 and 80 lb. to an acre, are applied in two split equal doses during pre-blossom and post-monsoon season. Fixed levels of phosphoric acid and potash at 30 and 40 lb. to the acre respectively, are applied during the post-monsoon season. Pruning is done in the pre-blossom period.

(*a*) The yield data of the experiment at Bhadra Estate are given in Appendix XII. The yield data for the past seven years have not given significant

results. However, the plot receiving 80 lb. nitrogen with pruning has given numerically higher yields for the second year in succession.

The experiment is being continued.

(*b*) The yield data of the trial at Devadhanam Estate are furnished in Appendix XIII. The yield differences during the past six years are not significant. However, during this year the plots receiving 80 lb. nitrogen with pruning and without pruning have given significant results over other treatments. The experiment could not be continued since no agreement was reached with the planter on the question that the present levels of manure application for the experimental plots was not sufficient when compared with the levels of manure application in the estate.

From the above manurial trials conducted at the Coffee Research Station, Balehonnur, and in two private estates over a number of years, it appears that application of 80 lb. nitrogen with 30 lb. phosphoric acid and 40 lb. of potash per acre with or without pruning is likely to result in the better cropping of the robusta bushes.

IV. Experiment on the Influence of Topping on Growth and Yield of Robusta Coffee—Byregudda Estate, Balehonnur

This experiment was laid out at Byregudda Estate, Balehonnur, in the year 1951 to study the effect of topping robusta plants at 3 feet or 91·5 cm. and 4 feet or 122 cm. heights respectively. The plants at the time of the treatments were three years old. Growth increments recorded showed that though in the initial years plants topped at 3 feet or 91·5 cm. height registered better growth, later on they tended to be *on par* with the plants topped at the higher level, 4 feet or 122 cm. Since the bushes have closed in and covered the ground completely recording of length and girth measurements were considered no longer necessary and they have been discontinued.

The yield data are furnished in Appendix XIV.

The yield differences during the year are not significant. However, plants topped at 4 feet height registered numerically higher yields for the fourth year in succession.

The recording of yield is being continued.

V. Mulching Trials on Young Arabica Coffee

Two trials started during the year 1957 to find out the effect on growth and yield of young arabica coffee by mulching, growing green manure and cover crops were continued. The trials were laid in clearings planted with arabica selections, in L_2 Block of the Coffee Research Station, Balehonnur.

(*a*) *Mulching Experiment—Coffee Research Station, Balehonnur.*—Green manure and cover crops used in the trials are *Crotalaria anagyroides* and *Calopogonium mucunoides* respectively. The green manure crop was cut periodically

to a height of about 18 inches whenever it was in flowers and the cuttings used as mulch to the coffee. The yield data and growth measurements are furnished in Appendix XV.

The results during the second crop year have not been significant. However, the plot mulched with cherry husk has given numerically highest yields during this year.

(*b*) *Mulching*-cum-*Manurial Experiment—Coffee Research Station, Balehonnur.*—Two types of mulches were applied in December 1958. Two levels of 20–30–40 and 40–30–40 NPK mixtures were applied in two doses one in pre-blossom and again in post-monsoon period. The yield data and growth measurements are furnished in Appendix XVI.

The results during this second crop year are not significant. However, the plot receiving 20 lb. nitrogen *plus* dry leaf mulch has given numerically higher yields.

The experiment is being continued.

VI. Studies on Crop Estimation

Pilot studies were conducted from 1957–58 to devise a more accurate method of estimating the crop than the erstwhile system of 'eye' estimates on the blossom. Interesting results were obtained from the technique known as 'Kenyan selective stripping' in the 2–3 months period before harvest as reported in 1957–58 Annual Report. During the year the trials were conducted at the two stations and extended to 37 estates in the several Coffee Liaison Zones of South India. The technique in brief consists in the stripping of randomly selected plants from different blocks in the estate and calculating the yield of coffee for the block and then the estate after making due allowance for non-bearing and young bushes.

The estimates of crop based on the complete stripping method are furnished in Appendix XVII. From the results it is observed that in many cases the actuals are near to the estimated yields on either first or second strippings. In these the variation between the actual and the estimated yields varied from 0·8 to 24·3% in about 61% cases. Noticeable variations are however present in the first and second strippings.

Based on the above observations it is proposed to further continue the studies in the estates in different Liaison Zones with the object of determining the right time of stripping and to standardise the methods and computations for large-scale adoption of the technique.

VII. Trials with Growth-Promoting Substances and Other Proprietary Products

(*a*) *Nikota—S.* 271.—This is a proprietary product of Messrs. Prithvi Trust, Bombay, claimed to have growth-promoting properties. An exploratory trial was initiated during February 1958 to find out the effect of this on coffee blossom. Two concentrations of the chemical, *viz.*, $\frac{1}{4}$ lb. and $\frac{1}{8}$ lb. in 5 gallons of water along

with two concentrations of Gibberellic acid, *viz.*, 25 and 50 p.p.m. were sprayed on Kents arabica coffee plants about a month prior to the expected date of blossom.

Periodical measurements on growth of selected branches, number of flower-buds produced and carried to maturity were done.

It was observed that the chemical did not seem to have any influence on the growth, blossom, and yield of coffee.

(*b*) *Naphthalene Acetic Acid* (*NAA*).—An exploratory trial with Naphthalene acetic acid to find its effectiveness in controlling fruit drop was initiated during May 1958. Three concentrations of NAA, *viz.*, 5, 10 and 20 p.p.m. were sprayed on coffee plants three weeks after flowering when fruit-set had occurred, along with Bordeaux mixture which is used for controlling leaf disease. Six trees were sprayed per each treatment along with control, which received only Bordeaux spray.

It was observed from the results that the chemical did not have any influence on fruit-set or fruit-shed of coffee.

VIII. Brazilian System of Planting

One acre of newly opened area at the Coffee Research Station, Balehonnur, was planted according to the Brazilian method, but retaining shade, during the year, 1956. Pits of $2\frac{1}{2}$ feet cube were opened at a spacing of 13×8 feet or $4 \times 2 \cdot 5$ metres. Four seedlings of S. 795 (a selection of arabica) were planted in each pit. While a majority of the pits were fully filled and the seedlings planted in the middle, 75 pits were only half-filled and the seedlings planted in them. It was seen that the latter were filled up very quickly with soil during the heavy monsoon rain in the year of planting itself. A thick stand of green manure was raised by sowing *Crotalaria striata* between rows of coffee, and the latter heavily mulched by cutting and spreading the green manure. The plants are making vigorous growth.

The experiment is being continued.

IX. Robusta Rehabilitation Trial

An observational trial was started at Coffee Research Station, Balehonnur, in 1958, on 28 years old robusta plants with the object of rehabilitating the plants for higher production level. The following treatments were given to the plot:—

(1) Wider spacing of robusta by cutting alternate plants in alternate rows and pruning the retained plants.

(2) Thinning, lifting and regulation of shade.

(3) Laying renovation trenches $1\frac{1}{2} \times \frac{3}{4} \times 8$ feet or $46 \cdot 7 \times 22 \cdot 9 \times 243 \cdot 8$ cm. in size.

The initial yield data for the block are recorded and given below. Observations are being continued:—

Name of the Block	Yield of ripe cherry in lb./acre	Yield of clean coffee in cwt./acre
1. Crawford area	1906	3·4
2. J. Block	1388	2·5

X. Experiments at the Coffee Research Sub-station, Chethalli

(1) *Soil Cultivation Experiment.*—A trial similar to the one at the main Station was started in the year 1953 on mature arabica coffee at Coffee Research Sub-station, Chethalli. Different methods of soil cultivation such as trenching, renovation pitting, light and deep digging are under comparison against control which is given weeding only. The yield data of the experiment are given in Appendix XVIII.

The yield differences, for the past five years, have not given any significant results. The results are conflicting from year to year. The experiment is however being continued for necessary further observation.

(2) *Studies in the Shade Requirement of Arabica Coffee.*—An experiment to find out suitable types and combinations of shade trees for optimum growth of arabica coffee was laid out in 1955–56 in a newly cleared area.

The treatments constituted by grouping nine out of ten shade trees for each treatment, omitting one at a time.

Temporary shade has been provided all over the area uniformly by planting the same number of dadap stakes in each plot. All the plots received uniformly the several estate cultural operations and manures.

Observations on growth and development of coffee plants and yield are continued. The basic yield data during this year have been recorded and are given in Appendix XIX.

R. L. Narasimhaswamy.

Agronomist, I/C.

II. BOTANY

Inter- and intra-specific coffee breeding to combine resistance to leaf disease (*Hemilieia vastatrix* B. and Br.) and high yields were continued: (1) Collection and establishment of species, varieties, types and forms of coffee from outside India and South Indian Coffee Estates, (2) comparative trials of clonal progeny of good bearers and seedling progeny of selections and cross-breds for finding out

the behaviour of the progeny of selections and cross-breds to leaf disease and yields, (3) morphological and cytological studies, (4) examination of seed plots of approved selections for seed collection for supply to growers, (5) experimental and demonstration work on vegetative propagation of coffee by grafting and rooting of sucker cuttings, and (6) collection and establishment of shade tree species from sources in and outside India formed the principal work of the section.

Coffee seeds were obtained during the year by courtesy of (1) Dr. Branquinho d'Oliveira, Estacao Agronomica Nicional, Portugal (through the good offices of Mr. C. A. Krug, Tropical Crops Specialist, Agricultural Division, Food and Agricultural Organisation of U.N., Rome), (2) Director, Instituto Agronomico Do Estado De Sao Paulo, Campinas, Brazil, and (3) Head, Plant Introduction Section, Horticultural Crops Research Branch, United States Department of Agriculture, Beltsville, Maryland, U.S.A.

A. Coffee Breeding

1. Arabica

1. With a view to evolve leaf disease resistant, high yielding and vigorous strains, cross-breeding of arabica coffee was continued. Thirteen crosses were effected during the year. These are mostly in the nature of repeating the crosses done in the previous years to get larger populations for field studies for extended observations. Selected plants of S. 12 Kaffa, a collection from Ethiopia, reported to be showing indications of resistance to races I, II and IV, S. 881 and S. 882 collections from Rume and Barbuk Sudan respectively, exhibiting freedom from leaf disease in the field, were used for cross-breeding with selected plants in the 1st generation of S. 795 showing resistance to races I and II of leaf disease, S. 44 original mother plant selected from a collection from Kummergode Estate in Central Mysore showing resistance to races I, II and III of leaf disease, and Kp 423, a high yielding Kent selection from Lyamungu Station, established at Balehonnur. Further, selected plants in cultivars Padang and Philippinean possessing vigorous growth and good bean characters were used for crossing with selected plants from 1st generation of S. 795 with a view to improve the bean characters of the latter.

2. Field Studies of Advanced Generations of Selections and Hybrids

(*a*) In the observational trials started in 1952, the progeny of (1) three plants of S. 795, (2) one plant of S. 333, and (3) 5 intra-crosses of the arabica cultures of the BA series continued to be under study. The progeny of 3 plants of S. 795 have continued to show a very low percentage, up to 5% of plants with leaf diesase which also caused severe defoliation. The progeny have yielded their third full crop at between 6·7 to 8·6 cwt./acre during the year under report. This is similar to the yields reported last year (6·1 to 8·8 cwt./acre). The progeny of one plant of S. 333 have yielded 7·0 cwt./acre during the year as against 4·9 cwt./acre last year. Of the five intra-crosses, only one has so far consistently shown a low percentage, up to 9·3%, of leaf disease. In the other four, the number of plants showing

leaf disease appear to vary from year to year. It is up to 82·4% this year. The yields of these cultures has ranged from 3·93 cwt. to 7·54 cwt. to the acre.

(*b*) The 1953 series of plantings consist of 11 cross-breds and three hybrid collections from neighbouring estates. During the year under report all the cross-breds showed leaf disease susceptible plants varying from 14·3 to 70·9%. Five cross-breds which have consistently shown over 30% leaf disease susceptible plants from the past three years have been discarded. The second yield recorded from the 11 cross-breds has varied from 2 to 4·8 cwt./acre as against 0·3 to 4·6 cwt./acre last year. The three hybrid collections showed 15·2 to 36% susceptible plants during the year as against 12·8 to 39% last year. They recorded a low yield of 1·9 to 2·6 cwt./acre.

(*c*) Progeny of ten intra-crosses between arabica cultures planted in 1954 continued to be under study. Three of these cultures have remained free from leaf disease so far. The other seven intra-crosses continued to show a low percentage of plants with leaf disease, the range being 1·1 to 15%.

(*d*) Only one of the 9 intra-crosses planted in 1955 has so far remained free from leaf disease. The F_2 Gen. of S. 31, an arabica selection, cross-bred with Kents arabica—S. 333, has shown a low percentage of susceptible plants, up to 9·0%, as in the previous year. The remaining 7 intra-crosses exhibited leaf disease incidence as during the previous year.

(*e*) Three out of the 16 intra-crosses between arabica cultures planted in 1956 continued to be free from leaf disease. The remaining 13 intra-crosses have shown up to 21·3% susceptibility. Six cultures of S. 795, planted during the same year, did not show any leaf disease susceptible plants during the year.

(*f*) None of the 12 intra-crosses between arabica cultures planted in 1957 have shown leaf disease while in the previous year five of them had shown leaf disease ranging from 1·6 to 23%.

(*g*) During 1958, 10 intra-crosses between the progeny of Station Selections S. 288, S. 795 and S. 178, and S. 12 Kaffa and collections from Rume and Barbuk were planted in the field for study of their field performance.

3. Comparative Trials of Seedling Progeny of Selections of B.A. Series

The trials laid out during 1956 with seedling progeny of 20 arabica cultures of the B.A. series as reported in the Annual Report for 1956–57 was continued. These cultures continued to maintain resistance to leaf disease in the field during the year. They are growing vigorously.

4. Comparative Trials of Clonal Progeny from Best Performers

(*a*) *B.A. Series I.*—The randomised replicated trial to test the comparative merits of 20 arabica cultures (B.A. 5, 6, 11, 12, 13, 19 to 27, 30 to 32 and 34 to 36) planted in 1951 and 1952 was continued. The cultures maintain freedom from leaf disease in the field, as in the previous years. The average yields of the cultures

in terms of clean coffee per acre is given in Appendix XX. B.A. 11, 12, 13, 19, 20 and 23 continue to lead the other cultures as in the previous years.

(*b*) *B.A. Series II.*—The randomised replicated trial to test the comparative merits of 16 arabica cultures (clonal progeny of B.A. 1, 4, 7, 8 to 10, 13 to 18, 28, 29 and 33 seedling progeny of B.A. 19) planted during 1952 and 1953 was continued. The cultures under trial continue to show freedom from leaf disease in the field as in previous years. The average yields of the cultures in terms of clean coffee per acre are given in Appendix XXI. B.A. 18, 16 and 28 are continuing to lead the other cultures.

5. Observational Studies on the Performance of the Progeny of Outstanding Plants Selected from Private Estates

(*a*) Fourteen of the eighteen collections which were retained for observations have again shown varying percentages of susceptible plants ranging from 6 to 63% as against 6 to 13% last year. Observations on blossom indicated that some of the collections show floral abnormalities like petallody and star flowers. Their yield during the year was again low and has ranged from 1·16 to 3·2 cwt. to the acre as against 0·6 to 4·8 cwt./acre last year.

(*b*) Plants established during 1956 from a collection each from Woger Estate (Mysore State) and Kogilahalla Estate, Coorg (Mysore State) showed 14% and 13% leaf disease susceptibility respectively during the year as against 10·3% and 6·4% in 1957–58 and 10·6% and 38·6% in 1956–57. The percentage of susceptible plants has varied from year to year since planting. Further observations are in progress.

(*c*) Fifty plants were established during 1957 from two collections from Kotada Estate (Nilgiris, Madras State). One of these collections has shown 4% susceptible plants during the year while in the previous year it had shown 38% susceptible plants.

(*d*) Marking of outstanding plants in private estates was continued.

(i) Seedlings raised from four marked plants in Seaghalli hybrid plots in Sulgode Estate, Saklespur, Mysore State, have been planted in the field at the Station during the year. These marked plants were showing freedom from leaf disease in the field, exhibiting vigorous growth and carrying a good crop.

(ii) Seedlings raised from seeds from some old coffee bushes showing freedom from leaf disease in Kotada Estate (Nilgiris, Madras State) were kindly supplied by Messrs. Stanes Amalgamated Estates. These are being raised in the nursery for later planting in the experimental plots.

6. Interspecific Crosses

(*a*) Study of interspecific hybrids with particular emphasis on robusta-arabica hybrids, their back-crosses and self-bred progenies, was continued. A co-ordinated

study on cytological and morphological characteristics as well as leaf disease resistance and yield was also continued.

(i) *Robusta* × *Kents Arabica Hybrids and Progenies*

Plants in BC 1 and BC 2 with Kents arabica which showed resistance to leaf disease in the field during 1957–58 continued to maintain this resistance. However, one selected highest yielding plant in BC 2 (31 cwt./acre during 1957–58 and 12 cwt./acre during 1958–59) showed a few isolated spots of leaf disease on a few leaves during 1958–59.

All the plants in BC 1 with robusta and its open pollinated progeny continued to be free from leaf disease.

These plants in BC 1 or BC 2 with Kents arabica as well as robusta responded well to blossom showers of 48 cents and over, though paddying of buds up to 20% in a few plants was noticed. These latter have been discarded from further work.

High percentage of pea-berry and floats noticed in the previous year was observed this year also. (Pea-berry varies from 12·8 to 80·0%, and floats from 2·0 to 21·7%.) The occurrence of false-polyembryony, which is responsible for formation of bits and hollows in triage, is seen to be low being up to 5% and compares favourably with the older established commercial varieties like Kents and Coorgs arabica in which it occurs up to 4·6%.

(*a*) Progeny from one plant in BC 1 with Kents arabica further back-crossed to Kents and (*b*) self-bred progenies from selected plants in BC 1 and BC 2 with Kents arabica were planted for field studies during the year.

Two plants selected on the basis of freedom from leaf disease in the field, vigorous growth and high yield (up to 11·6 cwt./acre), in the open pollinated progeny from BC 1 with robusta, were selfed and also crossed with Kents arabica during 1958–59.

(ii) *Crosses between Diploid Species*

Crosses between *C. excelsa* and *C. eugenioides*, and *C. robusta* and *C. eugenioides* were effected during 1955. Sixty-two plants from the first cross and 2 plants from the second were established in the field.

(1) *C. excelsa* × *C. eugenioides*.—Seven plants resemble the *excelsa* parent and the rest show wide variation but with comparatively closer resemblance to *eugenioides* parent. 3·2% of the plants are so far seen to be susceptible to leaf disease in the field.

(2) *C. robusta* × *C. eugenioides*.—The two plants in this cross resemble closely the robusta parent. Reciprocal crosses between the two parents have been effected during the year to obtain a larger population for extended observations.

(*b*) *Devamachy Hybrid Collections*

Nine out of ten crosses between Devamachy hybrid collections, arabica selections and other collections reported in the earlier Annual Reports (1954–55 and

1955–56) have shown upto 40% susceptible plants as in the previous year. One cross with wild arabica from Anglo-Egyptian Sudan collection has continued to remain free from the disease.

Four crosses between Devamachy hybrid collections and S. 795 and S. 333 were established in 1957. Three crosses have remained free from leaf disease in the field so far, while one of these which showed 14·3% susceptible plants during the previous year appeared to be free during the year under report. Observations are in progress.

II. Robusta

1. Comparative Trials of Seedling Progeny from Best Performers : BR Series

The trial laid out during 1956 with the seedling progeny of 12 robusta cultures of the BR Series described in the Annual Report for 1956–57 was continued. The plants which are now in their third year are growing virgorously.

2. Comparative Trials of Clonal Progeny from Best Performers

(*a*) *BR Series I.*—The randomised replicated trial to test the comparative merits of ten robusta cultures (BR 2, 3, 5, 6, 7, 9, 11, 12, 15 and 17) planted in 1951 and 1952 was continued. The average yield of cultures in terms of clean coffee per acre are given in Appendix XXII. BR 5, 6 and 12 show higher yields than other cultures.

(*b*) *BR Series II.*—The randomised replicated trial to test the comparative merits of ten robusta cultures (clonal progeny of BR 1, 4, 6, 8, 10, 13, 14, 16 and 17 and seedling progeny of S. 274 robusta) planted during the years 1952 and 1953 was continued. The trees are in their first yields. The calculated yield in cwt./acre is given in Appendix XXIII. BR 10 and BR 14 are leading the others in yield.

3. Observational Trials on the Performance of the Progeny of Outstanding Plants Selected from Private Estates (Field Collections)

Plants raised from seeds of 40 marked plants in Hope Estate, Coorg, Mysore State, were established at Balehonnur Station during 1956. The collections are showing vigorous growth.

III. Collection of Coffee Seed Material from Countries Outside India

Collection of seeds of coffee species, varieties and selections from countries outside India was continued.

1. World Collections—1953 Series

Brazilian coffee types *Bourbon amarelo*, *Bourbon varmelho*, *Caturra amarelo*, *Laurina margogype* and *Mundo novo* have proved to be very highly susceptible to leaf disease on the Station and continued to show heavy defoliation due to the disease during the year, in spite of protective sprayings with Bordeaux

mixture. In the second year of cropping, *Bourbon vermelho*, *Bourbon amarelo* and *Mundo novo* yielded (calculated) at 6·9, 5·7 and 5·6 cwt. per acre respectively while the other two varieties yielded below 2 cwt./acre crop. The progeny of selections B.A. 1, B.A. 12, B.A. 16 and B.A. 19 planted for comparison showed up to 25% leaf disease susceptible plants. The calculated yield of these plants during the year is 6·0, 3·3, 3·8 and 8·2 cwt./acre respectively.

2. World Collections—1954 Series

Twenty-seven varieties of arabica received from Guatemala, Belgian Congo, and Ethiopia, seven arabica selections from Coffee Research and Experimental Station, Lyamungu, Tanganyika, and Kawisari B and D from Indonesia, planted along with Station Selections S. 288 and S. 446 continued to be under observation. Most of the arabica collections and S. 446 continued to show susceptibility to leaf disease under the conditions at the Station. A few leaves on 80% plants in Taffarikela and 84·7% plants in S. 12 Kaffa showed isolated spots of leaf disease. No defoliation in these due to the disease has occurred. Observations over the last three years have indicated that 20% plants in Taffarikela and 15·3% plants in S. 12 Kaffa continue to maintain freedom from leaf disease in the field. These resistant plants continued to be under observation. The first full crop was harvested from these varieties during the year. Padang, Blue Mountain, Taffarikela, Philippinean and Goudaloupe recorded between 6 and 7 cwt./acre, while Pache, Sumatra, Murta and Kent Selection KP 423 (Lyamungu) recorded between 5 and 6 cwt. to the acre.

Columnaris has failed to produce blossom buds so far. Samples from Blue Mountain, Padang, Philippinean, S. 12 Kaffa, Taffarikela and from Rume collections have been sent abroad for cup quality tests.

3. World Collections—1955 Series

Forty-two arabica varieties, Kawisari B and D, and *C. stenophylla*, *C. canephora*, *C. deweveri excelsa*, *C. racemosa* and *C. ligustroides* collected from Liberia, Belgian Cango, Tanganyika, Portugal and Ceylon continued to be under observation. All the introduced arabica varieties show susceptibility to leaf disease on the Station as well as all plants in *C. stenophylla* and *C. deweveri excelsa*. Isolated infections on a few leaves have been observed on *C. canephora* also.

4. World Collections—1956 Series

Sixty varieties, forms and types of arabica, *C. salvatrix*, *C. eugenioides*, *C. canephora*, *C. robusta Laurentii*, *C. liberica arnoldiana* and *C. liberica aruvimiensis* obtained from the United States Department of Agriculture, Guatemala, Ethiopia, Liberia, Tanganyika, France and Ceylon, continued to be under observation. Eniamba Kaffa and Misan Taffarikela from Ethiopia which did not show leaf disease during the previous year, however, showed isolated spots on a few leaves in a few plants. Sudan Barbuk has so far remained free from leaf disease and is

kept under continued observation. All the remaining materials showed susceptibility to leaf disease.

5. World Collections—1957 Series

Twenty-seven varieties, forms and types of arabica and *C. canephora* obtained from United States Department of Agriculture, Kenya, Uganda, Brazil, Ethiopia and Viet Nam were planted during 1957. Of these, progeny from two selfed individual plants of variety Geisha sent from Estacion Experimental Agricola, University of Peurto Rico, through United States Department of Agriculture, have so far remained free from leaf disease.

6. World Collections—1958 Series

C. canephora, *C. robusta* (erect types from 3 individual trees), *C. congensis* from one marked tree, progeny from six individual plants reported to be *C. arabica* × *C. liberica* hybrids, *C. arabica* from Rume and Barbuk Sudan, BE 5 and 10 (collected from Dakia forest) which were received from Madagascar, Kawanda Research Station, Kampala, Uganda, and, United States Department of Agriculture, Beltsville, Maryland, U.S.A., were planted during 1958. These plants are under observation.

7. The following seed materials were received during the year under report and seedlings have been raised:—

(i) *Psilanthopsis kopakata*	Head, Tropical Crops Introduction Section, U.S.D.A., Horticultural Crops Research Branch, Beltsville, Maryland, U.S.A.
(ii) No. 113—S. 6 Cioccie No. 1132—S. 6 Cioccie No. 1105—S. 4 Agaro No. 1102—S. 4 Agaro No. 128—Dilla and Alghe No. 6811—U.L. Dalecho No. 134—S. 12 Kaffa	Dr. Branquinho d'Oleivira Rust Research Centre, Portugal: Through the courtesy of Mr. C. A. Krug, Tropical Crops Specialist, F.A.O., Rome
(iii) Cera Erecta Laurina Bourbon vermelho Murta Amarelo	Director, Instituto Agronomico Do Estado De Sao Paulo, Campinas, Brazil

The material sent by Dr. Branquinho d'Olievira are mentioned as being resistant to races I, II and IV (W. W. Mayne's) except 1105—S. 4 Agaro.

8. Collection of coffee material received since 1953 from institutions outside India consist of 128 varieties, forms and selections of arabica coffee, 4 types of liberica coffee, 10 types and selections of robusta coffee, 2 types of excelsa, racemosa, salvatrix, Kopakata, Kawisari B and D, congensis, stenophylla and eugenioides.

B. Extension Work with Selections

Seed Blocks

(*a*) The seed blocks established at Balehonnur Station with S. 795, S. 947, S. 532 and S. 846 during 1954 and 1955 were maintained. The plants, particularly, S. 795, are showing vigorous and healthy growth. The first full crop was harvested from the 1954 seed plots. S. 795 has yielded at the rate of 4·6 cwt./acre followed by S. 947 with 3·3 cwt. to the acre. The other selections have yielded at the rate of 1·2 cwt./acre.

(*b*) The scheme of establishing zonal seed plots of Station Selections on private estates initiated during 1954–55 to help in meeting the increased demand for seeds was continued in respect of S. 795. The demand for seeds of all other Station Selections was met from seed produced at the two Stations. During the year seed coffee of S. 795 was collected in zonal seed plots in the following estates. Rogueing of off-type plants were done as in previous years, and, seed preparation continued under the supervision of the Research Department.

Mysore State

1. Bagneheddal Estate, Chikmagalur P.O.
2. Urvinkhan Estate, Javali P.O.
3. Kibbeta Estate, Somwarpet P.O.
4. Balagunda Estate, Somwarpet P.O.
5. Madapur 'A' Estate, Madapur P.O.
6. Hardoor Estate, Suntikoppa P.O.
7. Pannia Estate, Suntikoppa P.O.

Madras State

8. Glenvans Estate, Ouchterlony Valley Estates (1938) Ltd., New Hope P.O., Nilgiris.

818¾ lb. of arabica selections, 1,324¾ lb. of robusta selections and 52 lb. of excelsa were prepared at Balehonnur Station and delivered to the Senior Liaison Officer (Development) for distribution.

15lb.–10 oz. seeds of arabica selections and 4 oz. seeds of robusta were supplied to (1) School of Tropical and Sub-Tropical Agriculture, West Germany, (2) Dr. Raja Singh, M.D., Manilla, Philippines, (3) Director National of Agriculture, Saigon, Viet Nam, (4) United States Operation Mission, Laos, through American Embassy, New Delhi, and (5) Head of the Division of Botany, I.A.R.I., New Delhi, for supply to Chinese Peoples' Republic.

C. Vegetative Propagation

1. Grafting

Trials to find out an easy technique for grafting on robusta or moribund or hybrid stocks were continued.

The technique of conversion of robusta or moribund or hybrid stocks without stumping them at first, by wedge-grafting the green tender suckers arising on the main stem at 12 to 15 inches from ground level was standardised and advocated for adoption for large-scale grafting on private estates. One estate in the neighbhourhood of the Station which adopted this technique on a 15-acre block of robusta has registered over 60% success. Grafting on this estate was done by trained mazdoors. Encouraged by this initial success grafting has been extended on this estate during 1959 and 80% success registered.

A new feature in grafting demonstration was initiated during the year: the demonstrations were regionalised and were held by each of the Liaison Officers in selected estates in their zones. This enabled a large number of both big and small acreage growers to witness the demonstrations. Such demonstrations were held in 16 selected estates in 7 Liaison Zones in Mysore and Kerala States.

Trials on further improvements in grafting technique under study include using of local materials like plantain fibre, agave fibre and alkathene strips for binding the graft union as well as replacement of paper tubes with alkathene covers for the grafts.

2. Rooting of Sucker Cuttings

Trials with two proprietary products, *viz.*, Seradix L. 15 and L. 30 and cow's urine extract for treating single-noded green sucker cuttings before inserting them for rooting in propagation chambers, was repeated for the third year in succession. Treatment with Seradix L. 15 has recorded 73·3% rooting followed by Seradix L. 30 with 60·0%, cow's urine extract with 42·2% and untreated control with 31·2%. The trials with hormone products for rooting the cuttings are continued.

D. Multiple *versus* Single Stem System of Growing Coffee

1. Four sets of observational trials on the multiple *versus* single stem system of growing coffee were laid out in 1950 and 1951 with a view to gain local knowledge on the relative merits of these two systems. Growing of coffee on multiple stem is a common practice in East Africa and Central America. It is to be noted that in these countries, multiple stem coffee is grown without shade canopy. The trials at the Station are continued and the yield data are given in Appendices XXIV to XXVII.

2. Eight years' records from three sets of trials with arabica have indicated that in two trials single-stem plots have out-yielded multiple stem plots by 19·2% and 5·1% respectively; while in the third trial, the increased yield registered by the multiple stem plots over the single stem is upto 4·1%.

3. The trials with robusta shows that on the aggregate of 8 years yields the single stem plots have recorded 50% increase over the multiple stem plots.

4. The following disadvantages are noticed in the multiple stem system: (*a*) the multiple stems are liable to break during shade lopping and during high

monsoon winds, (*b*) the production of requisite number of suckers at the start to new cycle at the right time is not realised, (*c*) frequent damage of branches by mazdoors during picking and operations like BHC swabbing, etc. (with arabica varieties), (*d*) problem of ground coverage during dry months unless heavy mulching is resorted to, and, (*e*) incidence of shot-hole borer on multiple stems in robusta results in the total drying of affected primaries and consequently crop loss.

E. Laboratory Studies

Cytological studies were continued to define the chromosomal make-up of species, varieties, selections and interspecific hybrids of coffee.

1. Studies in Kents Arabica

During the year the studies were limited to a study of meiotic behaviour in the haploid plant among Kents arabica isolated during 1957–58. During meiosis tri- and quadrivalents are seen to be formed up to 32% pollen mother cells. This plant produced a few peaberries by open pollination. Seedlings raised from these seeds appear to give tetraploids as well as haploids.

2. Tetraploidy in Robusta induced by Colchicine Treatment

The two robusta plants in which doubling of chromosomes was induced by treatment with colchicine, as reported in the earlier reports, continued to be under study. They came to flower in March 1958. There was profuse flowering in both the plants; but, later set was poor, and, the few fruits harvested were defective: they showed either empty locules or shrivelled endosperm.

3. Triage Studies in Coffee

Cytological, morphological and embryological studies initiated under this project during 1958 as reported last year were continued.

(i) *Study of Development of Locules and Ovules in the Ovary as well as Comparison of Embryology of Kents Arabica, Coorgs Arabica and Station Selections S.* 795 *and S.* 288.—(*a*) Developing fruits of Kents and Coorgs arabica, S. 26, S. 288 and its progeny, and S. 795 and its progeny were analysed. Clean coffee was also analysed from marked individual plants in them. These studies indicate that false polyembryony occurs in these cultivars and selections. Due to this, bits, hollowed beans and other abnormal beans of triage are produced. The initiation of more than one ovule per locule (false polyembryony) is found to be high in S. 26, S. 288 and its progeny ranging from 28·3 to 48·3%, and in S. 795 being 18·9%. It is low in Kents and Coorgs arabica being 4·0 to 4·6%; In the progeny of selected plants from S. 795 it is noticed to be comparatively low being from 8·9 to 13·1%.

S. 26, S. 288 and its progeny show abortion of ovules at various stages of development both in normal and polyembryonic locules, and, this occurs up to 19·4%. This abortion tends to (1) reduce somewhat the production of triage, and (2) to

increase the percentage of peaberry. Empty locules are also produced by this abortion.

It is seen that in S. 947 (III Gen. of S. 288) this abortion is least, as is seen by the low (7·4%) empty beans (floats) and peaberries (9·3%). This culture however has shown a high (48·2%) percentage of false polyembryony.

(*b*) True polyembryony (occurrence of more than one embryo in the same ovule) is observed to occur to the same extent in Kents and Coorgs arabica and in the selections S. 288, S. 795 and their progeny, though S. 795 has shown a slightly higher percentage. Coorgs and Kents arabica show 0·15%, S. 288 and progeny show 0·15% and S. 795 and progeny show 0·31%.

(*c*) Three bean fruits (trilocular), black beans, brown beans and subnormal beans occur up to the same extent in Kents and Coorgs arabica and in the selections studied. Their occurrence is up to 1·6%.

(*d*) Malformed beans may also arise due to causes other than those mentioned above which are not yet understood. This category appears to form the major percentage of triage in Kents and Coorgs arabica and a very minor one in the case of selections.

(ii) *Study of the Extent of Hybridity in S.* 795, *S.* 288 *and Kents Arabica*— In this study pollen grain analysis was taken up. Pollen was studied from individual plants of S. 26, S. 288 and its progeny, and S. 795 and its progeny. The occurrence of sterile grains was observed to vary from 10 to 89·9% in S. 26, S. 288 and its progeny, 20 to 54% in S. 795 and 5 to 89·9% in the progeny of S. 795. A majority of plants in (*a*) S. 26, S. 288 and its progeny appear to produce 20 to 40% sterile grains; (*b*) S. 795 produces 30 to 40% sterile grains, and, (*c*) in the progeny of S. 795, a large majority produces 10–30% sterile grains. Comparative figures for Kents arabica are being recorded. Further studies are in progress.

(iii) *Study of Positional Effect on Fruit Development Leading on to Triage.*— The effect of (*a*) maturity of cropping wood and (*b*) thinning of crop by pruning on the development of fruit and production of triage was studied. The data collected are insufficient and are of a preliminary nature. Further studies are in progress.

(iv) *Study of Nutritional Effect on Fruit Development Leading on to Triage.*— Analysis of clean coffee samples from Kents arabica of the manurial experimental series of the Chemistry Division was done. Though the study indicates that in plots receiving nitrogen alone, the triage percentage is less by 4%, the data from one year's study are too insufficient for drawing any conclusions. Further studies are in progress.

(v) *Study of the Climatic Factors inducing Triage Production.*—There is as yet no presentable data on this, but studies are in progress.

F. Miscellaneous Crops

Shade Trees for Coffee

1. 1 lb. seeds of *Mæsopsis eminii* was supplied to Maruvahalla Estate in the North-East Monsoon Zone in Nilgiris.

2. Cuttings of *Erythrina* sp. received from Manager, Kannan Devan Hills Produce Co., Munar, and seedlings of *Erythrina speciosa, Schizalobium parahybum, Peptadeniya macrocarpa* (seeds received from Brazil) and seedlings of *Albizzia sumatrana* (seeds received from Chief Scientific Officer, U.P.A.S.I.) were planted in the field. *Erythrina speciosa* appears to be a thorny species and also its growth is rather slow when compared to other *Erythrina* sp.

The growth of *Cordia abyssinica, Albizzia maranguensis and A. coriaria* planted during 1956 has been particularly vigorous.

3. In the shade collections at Balehonnur Station the following are included:—

Erythrina speciosa, E. tomentosa, E. torulosa, Erythrina sp., *Albizzia maranguensis, A. coriaria, A. sumatrana, Acacia elata, Entada abyssynica, Milletia oblata, Cassia javanica, Cordia abyssinica, Ruprechtia vivoru, Trema guienensis* and *Machærum tipu.*

G. Experiments at the Coffee Research Sub-station, Chethalli

The varietal trial laid out during 1949 to test the Station Selections S. 795, S. 288, S. 645 and S. 446 as described in the earlier Annual Reports was continued. The eighth crop from these plants were harvested. The data is furnished in Appendix XXVIII.

A sharp fall is noticed in the yields during the year under report. This perhaps is due to (1) the prolonged and delayed harvest of the previous high crop which appears to have inhibited flower-bud development and (2) unfavourable seasonal conditions. The aggregate of eight years yields shows that S. 795 has out-yielded others, followed in order by S. 645, S. 288 and S. 446.

R. L. Narasimhaswamy,

Botanist.

III. CHEMISTRY

Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on growth and health factors, moisture and temperature on the opening of blossoms, hormones on fruit-set and studies on the processing of coffee formed the main items of work of this division. The division also attended to the routine examination of soils for advisory work and undertook visits to problem areas for investigation and advise on soil and crop husbandry.

Field Experiments

A. Manurial Experiments

(*i*) Studies on the Essential Requirements of Plant Foods NPK in Relation to Improvement in Yield (New Manurial Series)

This experiment laid out in the year 1937 has completed 19 years of observation. As reported earlier in the Annual Report for 1954–55, plant population in each plot was halved from 40 to 20 plants. The yields have first been calculated on the present population of 20 plants for purposes of comparison over the years. The results are summarised in Appendix XXIX.

It is seen that the treatments have not been significant. Treatment N + P misses significance narrowly. The trend however is the same as in the previous years, *i.e.*, N + P, N + P + K, N + K, N and control.

The average yield of ripe cherry for 19 years and clean coffee for 11 years have been analysed statistically and the data are presented below:—

Average yield of ripe cherry in lb./acre over 19 *years*

	S.E. as % of gen. mean	C.D. at P 0·05	Conclusions
A: 2474 B: 2890 C: 2525 D: 2809 E: 2130	3·73	294·5	$\underline{\overline{BDC}}\,\underline{A}$, E
Clean coffee in cwt./acre over 11 *years*			
A: 5·62 B: 6·53 C: 5·46 D: 6·07 E: 4·71	0·34	2·17	$\overline{BD}\,\underline{A}\,\overline{C}$, E

The data presented above reveal that the treatments are significant both in case of ripe cherry and clean coffee. Treatment B (N + P) is *on par* with D (N + P + K), and they are significantly superior to C (N + K) and E (Control) in case of clean coffee. All the treatments are superior to E (Control) both in case of ripe cherry and clean coffee. The same trends were observed in previous years also.

Statistical analysis of the average yields for four years in case of 20 : 30 : 40, 40 : 30 : 40 and 60 : 30 : 40 ratios have been carried out. The data are presented in Appendix XXIX. The treatments are significant both in case of 20 : 30 : 40 and 60 : 30 : 40, whereas they are not, in case of 40 : 30 : 40 ratio. Treatment

D (N + P + K) is *on par* with treatment B (N + P) and both are significantly superior to treatment A (N) only when the prevailing dosage was 20: 30: 40. Treatment B (N + P) is *on par* with treatment D (N + P + K) and both are significantly superior to treatments A (N) only, C (NK) and E (Control) when the prevailing dosage was 60 : 30: 40.

A composite analysis was carried out on average yields of 4-year periods when the prevailing dosages were 20: 30: 40, 40: 30: 40 and 60: 30: 40. This was with a view to study the effect of different combinations of N, P and K, on the yield of coffee, at different levels of Nitrogen with constant levels of P_2O_5 and K_2O.

The data are presented below:—

Main Treatments	Sub-Treatments A 20: 30: 40	B 40: 30: 40	C 60: 30: 40	Mean of Sub-Treatments	S.E. Main	S.E. Sub.	C.D. Main	C.D. Sub.	Significant or not Main	Significant or not Sub.
N	1·2	3·4	21·2	1·7						
NP ..	1·7	3·0	25·8	2·0						
NK ..	1·3	3·5	20·9	1·7					NO	YES
NPK	1·7	3·4	24·3	2·0						
Control ..	1·6	3·0	18·9	1·6						

Conclusions: Sub: C B A

It is seen from the data that the main treatments (different combinations of N, P and K) are not significant whereas, the sub-treatments (different ratios) are highly significant. Sub-treatment C (60: 30: 40) is significantly superior to the 40: 30: 40 and 20: 30: 40 ratios. The interaction due to submain treatments is also significant. Combination N + P at 60: 30: 40 level has recorded higher yields when compared with the rest.

The levels of N + P and K have been changed from 60: 30: 40 to 80: 45: 60 from the pre-blossom application (February) of 1959.

(*ii*) Studies on the Manurial Requirement of Coffee in Relation to Improvement in Yield

(*a*) *NPK Trials with Varying Levels of N, P and K* (*Fundamental Manurial Experiment in pH Cisterns*).—This experiment described in detail in the previous report was continued. The yield record and the percentage of floats in the harvest are presented in Appendix XXX.

The treatments are not significant in 1958–59 yield data. In the statistical analysis of the average yields over 6 years, treatments are not significant. However,

treatment A (20 : 30 : 40) has recorded high yields both in the case of ripe cherry and clean coffee. The same trend is noticed in the 1958–59 yield data also.

The statistical analysis of the percentage of floats by weight and volume shows that the treatments are not significant. However it is observed that the percentage of floats is greater this year than last year.

(*b*) *NPK Trials with Varying Levels of Nitrogen and Constant Levels of P and K* (*Manurial Experiments in* 17-*acre* 1952 *Clearing*).—This experiment described in previous reports was continued. Patchy blossom followed by a long drought adversely affected the crop. The yield record of the experiment is presented in Appendix XXXI.

It is seen from the data presented that the treatments are not significant both in the analysis of yield data for the year 1958–59 and the average of yields for 3 years. In 1958–59 treatment E (40 : 30 : 40) has recorded the highest yield whereas in the average of 3 years treatment B (80 : 30 : 40) has recorded the highest yield followed by treatments E (40 : 30 : 40), C (100 : 30 : 40), D (60 : 30 : 40) and A (Control).

(*c*) *NPK Trials with Constant Levels of NPK but varying Sources of Nitrogen* (17-*acre Manurial Experiments*—1953 *Series*).—This experiment started in 1953 was continued. Indifferent and patchy blossom resulted in a poor crop. Statistical analysis of the yield data reveals that the treatments are not significant. However treatment C (Calcium ammonium nitrate) has recorded the highest yield followed by treatments D (Urea), B (Control), E (Ammonium sulphate) and A (Chilean nitrate). The data are presented in Appendix XXXII.

(*d*) *NPK Trials with Varying Levels of P and K and Constant Levels of Nitrogen* (17-*acre Manurial Experiments*—1954 *Series*).—The 1958–59 crop, being the first full crop harvested, has been merely recorded. This forms the basic data.

(*e*) *NPK Trials with Varying Levels and Combinations* (*Arabica Manurial Experiments at the Coffee Research Sub-Station, Chethalli, Coorg*).—This experiment started in 1952 was continued. Yield record for the year 1958–59 is presented in Appendix XXXIII.

Statistical analysis of the yield data reveals the following points:—

(1) Main effects due to nitrogen and potash are not significant.

(2) Factor P is significant.

(3) Increase in yield is noticed with the increase in the application of nitrogen.

(4) There is a significant increase in yield with increase in phospate application.

(*f*) *Studies on the Effect of Aldrinised Fertilizers on the Yield of Coffee.*—The two experiments laid out in the two Research Stations, described in the previous Annual Reports, were continued. Yield records of the experiments are presented in Appendix XXXIV.

The treatments are not significant in both the experiments situated in the two Research Stations. In the experiment situated at Coffee Research Station, Balehonnur, treatment C (1·5 lb. of Aldrin) has recorded the highest yield during the year 1958–59 whereas last year it was treatment D (1·0 lb. of Aldrin) which recorded the highest yield. Treatment D (1·0 lb. of Aldrin) has recorded the highest yield in the experiment at Coffee Research Sub-Station, Chethalli, for the year 1958–59 but it was treatment C (1·5 lb. of Aldrin) which recorded the highest yield in the previous year. The experiments were concluded after the 1958–59 harvest.

(*g*) *Test-Scale Trials at Coffee Research Sub-Station, Chethalli.*—This experiment described in detail in the Eighth Annual Report (1954–55) was continued. The yield data from the experiment for the year 1958–59 are furnished below:—

Treatments	Yield of ripe cherry in lb. per acre		
	Block I N_2 applied in 2 equal doses	Block II N_2 applied in 3 equal doses	Mean
N_1 (40 lb./acre)	2492	1232	1862
N_2 (60 lb./acre)	1484	3095	2290
N_3 (80 lb./acre)	1005	2520	1763
N_4 (100 lb./acre) ..	4232	1600	2916
$N_2 + P$ (60 N + 30 P_2O_5) ..	2585	2550	2568
$N_2 + P + K$ (60 N + 30 P + 40 K)	1440	2210	1825

It is seen from the data presented above that application of nitrogen in 3 split doses appears to be more beneficial in bringing consistent yields, when compared with application of nitrogen in only 2 doses. This is in accordance with observations made last year.

(*h*) *Test-Scale Observational Trials on the Effect of Increasing Doses of Manures on Coffee.*—The two trials, one on arabica and the other on robusta laid out in May, 1956, were continued. Details of the trials are given in the Ninth Annual Report for the Year 1955–56. The yield data for the year 1958–59 do not follow any regular pattern of response to manuring. The experiments have been concluded after the 1958–59 harvest.

(*iii*) Field Trials to find out the Maximum Economic Dose of Nitrogen and the Role of Phosphates and Potash in Balancing Nitrogen Utilization

This trial started in May 1956 was continued. Yield record for the year 1958–59 are given in Appendix XXXV.

The treatments are not significant. The following trends are observed from the data.

Main treatment F (100 : 45 : 60) has recorded the highest yield closely followed by treatment B (800 : 360 : 480). In the case of sub-treatments, treatment 4 (N only) has recorded the highest yield closely followed by treatment 3 (N + basal dressing).

(*iv*) Field Trials in Private Estates

(*a*) *Studies on the Application of Nitrogen only in Divided Doses in Relation to Yield of Coffee* (*Ossoor Manurial Experiments*).--This experiment, laid out in 1953 in a private estate (Ossoor Estate, Saklespur), was continued. The yield record of the experiment is given in Appendix XXXVI.

The treatments are not significant both in the yield data for 1958–59 and the average yields for 6 years. The experiment has been concluded after the harvest of 1958–59.

(*b*) *Effect of Different Sources of Nitrogen on the Growth and Yield of Mature Yielding Coffee.*—This experiment started in April 1956 at Shegode Estate near Coffee Research Station, Balehonnur, was continued. The yield record of the experiment is presented in Appendix XXXVII.

Statistical analysis of the data showed that the treatments are not significant. Treatment D (Urea) has recorded the highest yield in 1958–59 harvest whereas treatment C (Ammonium sulphate) recorded the highest yield during the year 1957–58.

(*v*) Field Manurial Trials in Private Estates on Arabica Coffee

Out of the 10 trials started in 1954 in private estates situated in different soil climatic zones of South India, only 8 were continued (two were discontinued). The yield records for the years 1957–58 and 1958–59 are presented in Appendix XXXVIII.

The statistical analyses of the yield data for 1958–59 from the different estates show that both the main and sub-treatments are not significant in any one of the estates. Further examination of the data reveals the following trends:—

(1) Amongst main treatments, treatment C (80 : 30 : 40) has recorded high yields in 4 out of 8 estates.

(2) With regard to sub-treatments the results are varying to draw any conclusion.

Average yields from these experiments expressed as percentage of nitrogen (mean of N_1 and N_2) are presented in Appendix XXXIX.

The data indicate:—

(1) Treatments having P (NP and NPK) have generally recorded high yields (23 cases out of 32).

(2) At a basic level of 30 lb. P_2O_5, with nitrogen level at 60 and 80 lb. per acre, increased yields are observed in 7 out of 8 cases, but there is a decrease in such number of cases at higher (100 lb. per acre) and lower (40 lb. per acre) levels of nitrogen.

(3) With the addition of 40 lb. potash to the acre to form a complete NPK mixture increase in yields is noticed in 4 out of 8 cases at nitrogen levels of 40, 60 and 80 lb. to the acre, but there is only one such case at 100 lb. level.

(*vi*) Manurial Experiments on Robusta Coffee

(*a*) *NPK Trials with Varying Levels and Combinations at Coffee Research Sub-Station, Chethalli (Coorg).*—This trial started in 1954 was continued. The yield recorded this year forms the basic data.

(*b*) *Field Manurial Trials in Private Estates.*—The trials started in 1955 in four private estates in Wynaad (Kerala) and one in Saklespur (Mysore) were continued. The yield records for the years 1957–58 and 1958–59 are presented in Appendix XL. The treatments, both main and sub, are not significant except in Sulgode Estate, where only main treatments are significant. Further examination of the data reveals that sub-treatment NPK has recorded high yields in four out of five estates and main treatment C (80 : 30 : 40) has recorded high yields in three out of five estates.

The yield data from the treatment NP and NPK at different levels of nitrogen as percentage of the mean of N_1 and N_2 have been rearranged and presented below:—

Treatments		Krishna Estate	North Carolina	Pathripara	Chellote	Sulgode	Mean of 5 estates
Main	Sub						
40 lb. N_2/acre	(N)	100	100	100	100	100	100
40 lb. N + 30 lb. P_2O_5	(NP)	127	90	87	88	93	97
40 N+30 lb. P_2O_5 +40 lb. K_2O	(NPK)	104	104	156	111	107	116
60 lb. N_2/acre	(N)	100	100	100	100	100	100
60 lb. N + 30 lb. P_2O_5	(NP)	85	89	138	112	93	103
60 lb. N+ 30 lb. P_2O_5 + 40 lb. K_2O	(NPK)	97	93	83	110	141	105
80 lb. N_2/acre	(N)	100	100	100	100	100	100
80 lb. N+ 30 lb. P_2O_5	(NP)	123	103	91	123	81	104
80 lb. N + 30 lb. P_2O_5 + 40 lb. K_2O	(NPK)	92	85	78	122	125	100
100 lb. N_2/acre	(N)	100	100	100	100	100	100
100 lb. N+ 30 lb. P_2O_5	(NP)	121	115	118	110	126	118
100 lb. N+ 30lb. P_2O_5 + 40 lb. K_2O	(NPK)	85	136	150	145	151	133

The following points are noticed from an examination of the data presented above:—

(1) Treatments having P (NP and NPK) have recorded high yields in 17 out of 20 cases.

(2) At a basic level of 30 lb. P_2O_5 with nitrogen level at 40 and 100 lb. to the acre, increased yields are noticed in all cases (5) whereas, there is a decrease in such number of cases at 60 and 80 lb. levels to 3 and 4 cases out of 5 respectively.

(3) With the addition of 40 lb. potash to the acre to form a complete NPK mixture, increase in yields is noticed in 4 out of 5 cases at 40 lb. nitrogen level, in 2 out of 5 cases at 60 lb. nitrogen level, 2 out of 5 at 80 lb. nitrogen level and 4 out of 5 at 100 lb. nitrogen level. The mean of 5 estates shows that in all cases NPK gives higher yields than nitrogen only.

(*c*) *Field Trials on Robusta Coffee* (*Modified Robusta Manurial Trials*): (1) *Series I.*—The field trials started in Malabar, Wynaad (Kerala), Coorg and Mysore in 1956 were continued. The yield data from the experiments are presented in Appendix XLI.

The treatments are not significant. However, further examination of the yield data reveals that the treatment A (40 : 30 : 40) has recorded high yields in three estates out of seven.

(2) *Series II.*—The yield data from the experiments are presented in Appendix XLII. It is seen from the statistical analysis that the treatments are not significant except in the case of Mániankode Estate. The treatments are significant in Maniankode Estate. Treatment E (NPK) is *on par* with treatments C (NK) and D (PK), but it is significantly superior to treatments B (NP), A (N) only and F (Control). Treatment F (Control) has recorded the lowest yield and all the other treatments are significantly superior to it. A similar trend was observed last year in this estate. Means drawn for 5 estates for the different treatments show that treatment D (PK) has recorded the highest yield closely followed by treatments C (NK) and D (NP).

(*vii*) Experiments on the Response to Manuring of Coffee Seedlings in the Nursery: NPK Trials with Varying Levels and Combinations

Uniform plants from the nursery manurial trial started in 1956 have been planted with soil from the respective plots in the pots. Observations on growth and yield were continued. The first crop picked from this year forms the basic data. It is seen from the data that the yield is high in nitrogen-treated plots, but the same is not the case with pots without nitrogen. Severe nitrogen deficiency (yellowing and malformation of leaves) was noticed in plants without nitrogen and this resulted in defoliation.

(*viii*) Field Trials on the Effect of Minor Elements on the Growth and Yield of Coffee (Experiment with Chelates)

This experiment started in July 1957 was continued. The details of the experiment are furnished in the 10th Annual Report (1956–57). No visual differences in growth are observed.

(*ix*) Trials on the Effect of Application of Minor Elements and Chelates on the Growth of Young Coffee (Pot Culture Experiment in the Nursery)

This experiment was started in February 1959. The details of the experiment are given below:—

Treatments: 7; Replications: 6; Lay-out: Randomized; Plot Size: Single plant planted in a pot constitutes a sub-plot.

The pots were uniformly filled with a mixture of jungle soil, compost, ordinary soil and coarse sand before planting the seedlings.

Treatments

1.	A: Es-Min-El at 12 gm. per year per plant	N P K at 40 lb. N + 30 lb. P_2O_5 + 40 lb. K_2O
2.	B: Fritted trace elements ,, ,,	
3.	C: Sequestrene NaFe ,, ,,	
4.	D: ,, NaCu ,, ,,	
5.	E: ,, NaCa ,, ,,	
6.	F: Metaquest	
7.	G: Control	

The NPK mixture is made up of Ruhr's mixture, nitrophosphate, ammonium sulphate and muriate of potash.

Time and Mode of Application of Fertilizers.—The total quantity of fertilizers for the year is applied in four equal doses, *i.e.*, (*a*) pre-blossom (February-March), (*b*) post-blossom—pre-monsoon (May), (*c*) Break in the monsoon (August) and (*d*) post-monsoon (September-October).

The application of fertilizers commenced with the pre-monsoon of 1959. The fertilizers are applied uniformly all round the plants, away from the stem.

Observations to be Recorded:—

(1) Growth-measurements at intervals of one month from the start of the experiment.

(2) Flower formation, number of flowers and yield.

(3) Leaf samples to be collected one year after the application of treatments for the analysis of the three major nutrients, Fe, Cu, Ca and Mn, once in every 3 months.

(x) Studies to find out the Maximum Economic Dose of Nitrogen and the Role of Phosphorus and Potash in Nitrogen Utilization with and without Basal Dressing for Young Arabica Coffee: Experiment at '0' Block New Clearing planted in 1956

The first set of treatments were imposed in June 1959. The details of the experiment are given below:—

Area of Experimental Plot : 2·06 acres. *Lay-out :* Randomized.

Treatments : Main 12; Sub 4. *Replications :* 3.

Plot Size : Nett plot: $7 \times 7 = 49$ with common border rows in between adjacent plots. Each plot is split lengthwise and crosswise so as to form 4 sub-plots with the centre rows forming the common border rows in between sub-plots.

Shade : Natural mixed shade. *Spacing:* 6′×6′.

Main Treatments

1.	A	200 lb. N per acre
2.	B	80 ,, ,,
3.	C	360 ,, ,,
4.	D	120 ,, ,,
5.	E	400 ,, ,,
6.	F	280 ,, ,,
7.	G	40 ,, ,,
8.	H	240 ,, ,,
9.	I	0 ,, (control)
10.	J	440 ,,
11.	K	160 ,,
12.	L	320 ,,

Sub-treatments

Each plot receiving a main treatment is split into 4 quarters, and each quarter receives a sub-treatment. The sub-treatments are as follows: (1) Nitrogen only, (2) Nitrogen + basal dressing of rock phosphate, (3) Nitrogen + P and K and (4) N + P + K + Basal dressing of rock phosphate. Basal dressing of rock phosphate was given at the commencement of the experiment at the rate of 1 lb. per plant. The quantities of phosphoric acid and potash to be applied for the different main treatments are as follows:—

Main Treatment	P_2O_5	K_2O
A	150 lb.	200 lb. per acre
B	60 ,,	80 ,,
C	270 ,,	360 ,,
D	90 ,,	120 ,,
E	300 ,,	400 ,,
F	210 ,,	280 ,,
G	30 ,,	40 ,,
H	180 ,,	240 ,,
I	0 ,,	0 ,,
J	330 ,,	440 ,,
K	120 ,,	160 ,,
L	240 ,,	320 ,,

Time of Application of Fertilizers

The total quantity of fertilizers are to be applied as follows:—

Nitrogen at 40 lb. level is to be applied in two split doses during February and October, and at 80 lb. level to be applied in 4 split doses during February, June, August and October. Higher doses of nitrogen are to be applied in six split doses, once in two months, during February, April, June, August, October and December. The total quantities of phosphoric acid and potash are to be applied only in two equal doses during February and October.

Visual observations on growth and yield are to be recorded.

B. Cultural Experiments

(*i*) Studies on the Growth and Yield of Coffee in Relation to Shade Requirement (Hedge Row System of Planting)

This experiment started in 1953 was continued. A total crop of 3 cwt. of clean coffee was recorded from the experimental plot. Coffee under shade yielded more than coffee grown in open. The yield in terms of clean coffee per acre calculated on the number of bearing plants works out to 2·94 and 3·14 cwt. in the open and shaded areas respectively. Observations on soil moisture tension and meteorological observations have been discontinued after the collection of sufficient data over three years.

Laboratory

Work in the Laboratory consisted mainly of analysis of soils and plant samples collected by the Division.

(*a*) Studies on the Foliar Feeding of Plant Nutrients

Leaf samples, collected in May 1957 from the plants receiving foliar applications of plant nutrients NPK, are described in the 9th Annual Report for 1955–56. Analysis of leaf samples collected prior to application of treatments and 24, 48 and 96 hours after the application of treatments, was completed. The analytical data are presented in Appendix XLIII.

1. *Young Leaves*

Nitrogen.—An examination of the data shows that there is, in general, an increase in the total nitrogen content of young leaves collected 24 hours after the application of treatments. This falls off in the samples collected 48 and 96 hours after the application of treatments, with the exception of treatments N_2 and N_2P_2. Treatment A (N_1 20 lb. N per acre) recorded the highest percentage increase after 24 hours, whereas plants treated with N_2 (40 lb. N to the acre) and N_2P_2, (40 lb. N + 30 lb. P_2O_5) continued to absorb nitrogen even up to 48 hours.

Phosphoric Acid.—A general increase in the P_2O_5 content was noticed in young leaves collected 24 hours after the application of treatments, with the exception of treatments N_2 and N_2P_2, and decreased in the samples collected 48 and 96 hours after the application of treatments. Highest percentage increase in P_2O_5 content was noticed in treatment F (N_2K_2 40 lb. N + 40 lb. K_2O) closely followed by treatment H ($N_2P_2K_2$ 40 lb. N + 30 lb. P_2O_5 + 40 lb. K_2O). Increase in P_2O_5 content was continuous even up to 48 hours in the case of plants treated with N_2 (40 lb. N) and N_2P_2 (40 lb. N + 30 lb. P_2O_5).

Potassium.—Absorption of potassium (K_2O) in young leaves took place up to 48 hours after application of treatments; there being a decrease in K content of leaves in all the treatments in samples collected 96 hours after the application of treatments. Maximum absorption took place between 24 hours and 48 hours after the application of treatments. Absorption of K_2O was highest in plants treated with $N_2P_2K_2$, closely followed by N_1, N_2P_2 and N_1K_1.

2. *Old Leaves*

Absorption of nutrients in old leaves was slower and continuous even up to 96 hours after the application of treatments. However there is no regular increase pattern to draw any conclusion.

The following conclusions may be drawn from a study of the analytical data:—

(1) Absorption of plant nutrients is much quicker in young leaves than in old leaves.

(2) Maximum absorption takes place within 24 hours after the application of treatments, in the case of young leaves.

(3) Absorption in old leaves is slower and continuous even after 96 hours after the application of treatments.

(4) Nutrient solutions of lower strength are more readily acceptable than concentrated solutions both by young and old leaves.

(*b*) Analysis of Seedlings Collected from the Nursery Manurial Trials: Series II

This experiment started in March 1957 has been described in detail in the 10th Annual Report for the year 1956–57. The study was concluded during 1957–58 and results pertaining to observations on growth measurements, etc., are discussed in detail in the 11th Annual Report for the year 1957–58.

Seedlings were collected from the beds at regular intervals (once in two months) to study the uptake of plant nutrients by the seedlings. Samples were collected on:

1st Set	3rd August 1957
2nd Set	4th October 1957
3rd Set	4th December 1957
4th Set	4th February 1958
5th Set	5th April 1958
6th Set	30th June and 1st July 1958

The seedlings were cut, after taking growth measurements, into different parts (leaves, stalk and roots) and analysed separately. The samples were analysed for total nitrogen and organic carbon. Further analysis is under progress. The analytical data are presented in Appendix XLIV.

Total Nitrogen.—It is interesting to note that the nitrogen content in leaves of the seedlings collected for the 1st set was lower than the nitrogen content in stalk in all the treatments. There was a sharp fall in nitrogen content in stalks of the 2nd set in all the treatments while fall in nitrogen content in the case of leaves was very little. As the plants started growing older the nitrogen content in leaves increased. A critical examination of the data also reveals that there are fluctuations in nitrogen content in plants, and this follows a regular pattern of alternate increase and decrease. A clear increase in nitrogen content of leaves is noticed between the first and last set of seedlings collected. This increase is marked in case of plants receiving higher dosages of fertilizers. The same trends are noticed in case of stalks and roots, but there is a reduction in nitrogen content between the first and last set of seedlings collected. It is of interest to note that the nitrogen content increases with the increase in dosages of fertilizers, and also the nitrogen content is high in case of plants receiving NPK treatments. This would indicate that phosphorus and potassium help in better utilization of nitrogen by young coffee seedlings.

Organic Carbon.—Organic carbon content in leaves of the seedlings collected for the 1st set (August 1957) is high, but reverse is the case with regard to stalks and roots. The organic carbon content in leaves initially was high, but there occurred a sharp fall in the 2nd set of leaves collected in October 1957, and thereon it increased towards the end (6th set). Organic carbon content of stalks and roots increased from the 2nd set onwards till the end. In general organic carbon content in seedlings receiving NPK treatments is greater than in the seedlings receiving nitrogen alone. As the plants started growing older, the organic carbon content increased steadily towards the end when the final set of seedlings were collected.

Carbon/Nitrogen Ratio.—The carbon/nitrogen ratio in leaves of the 1st set of seedlings showed fairly average values. In the 2nd set there was a slight lowering of the values but this became steady and increased after the 4th set. Stalks and roots samples collected from the 1st set showed fairly average values but suddenly started increasing from the 2nd set onwards. This sudden increase in carbon-nitrogen value is the result of a sharp fall in nitrogen content in the 2nd set.

(*c*) Studies to Correlate Yield with Leaf-Nitrogen Content at the Time of Blossom

This study was started in April 1959 to correlate the yield with leaf-nitrogen at the time of blossom. Nine blocks in the Coffee Research Station, Balehonnur, falling in three different categories, *i.e.*, high, medium and low yielding were selected for this purpose. Two sets of samples, one before the blossom and the second a week after the blossom, were collected. The samples were analysed for total nitrogen, total ash, total P_2O_5 and total K. The data are presented in Appendix XLV.

It is seen from the data presented that there is a general increase in total nitrogen content of leaves collected after the blossom, whereas total P_2O_5 and total K values in the leaves collected after blossom were much lower than those collected before. These nutrient status values for different blocks will be compared with yield figures to be obtained later this year during the time of harvest.

(*d*) Flow of Water from the Subsoil Drains from the New Manurial Series Plots (Analysis of Lechates)

The subsoil drains in the New Manurial Series Plots, which commenced discharging from the 15th July 1958, had discharged 17,49,792 imp. gal. of water by the end of August 1958 when it finally stopped. The flow through the drains started when the rainfall had reached 66·58 inches. Ever since the introduction of these drains this is the first instance of such a large and continuous discharge over 45 days.

Representative samples of water were collected from the drains and analysed for total nitrogen, nitrates, total P_2O_5 and total K. The total quantity of nutrients lost due to leaching amounted to 26,630 gm. (58·8 lb.) of nitrogen, 1,925 gm. (4·2 lb.) of phosphoric acid and 14,802 gm. (32·7 lb.) of potassium. Though he amount of phosphoric acid leached out is very low when compared with the

nitrogen and potash, it is very much higher when compared with the losses that occurred in previous years. The losses with respect to nitrogen and potassium follow the same trend as observed during the previous years. The analytical data are presented in Appendix XLVI.

The drains started discharging again from 6th July 1959, and had totalled 21,91,916 imp. gals. of water by the end of July 1959, over a period of 26 days. The flow started when 58·78 inches of rainfall had occurred. Representative samples of water have been collected and are being analysed in the Laboratory.

Advisory.—Twenty-five samples of soil from Bengal, sent by the Director of Cinchona Plantations, twelve samples of soil from Travancore, and three from Sagar Area in the Mysore State were analysed and suitable advice tendered.

Nine samples of lime were analysed for their suitability for spray purpose and application to soil.

Cup-Testing of Coffee Samples received from Assam, West Bengal and Andhra Pradesh.—Twenty-two samples of coffee received from Assam, West Bengal and Andhra Pradesh were cup-tested for their quality and a report submitted. It is seen that out of the 18 samples received from Assam, 8 are above average quality and one about average.

The number of determinations carried out in the division during the year was as follows:—

1.	Moisture	611
2.	Total Exchangeable bases	62
3.	Mechanical Analysis	248
4.	Total Phosphoric Acid	289
5.	Total Potassium	268
6.	Available CaO	10
7.	Total R_2O_3	44
8.	Total CaO	44
9.	Total Nitrogen	623
10.	Organic Carbon	536
11.	Nitrate Nitrogen	55
12.	Loss on Ignition	36
13.	Insolubles in HCl	36
14.	Total Ash	165
15.	pH	72
16.	Total Fe_2O_3	36
17.	Total MgO	36
18.	Soil Tests	413
19.	Tissue Tests	816
20.	Cup-Testing	22
	TOTAL	4422

Experiments at the Coffee Research Sub-station, Chethalli

The following experiments were in progress during the year at the Coffee Research Sub-station, Chethalli:—

(1) NPK trials with varying levels and combinations on arabica described in para (*e*) page 62.

(2) Field Manurial Trials on arabica one among the ten described in para (v), page 64.

(3) Studies on the effect of the Aldrinised Fertilizers on the yield and growth of coffee described in para (*f*), page 62. concluded after the harvest of 1958–59.

(4) NPK trials with varying levels and combinations on robusta described in para vi (*a*), page 65.

(5) Exploratory Test Scale observational trial on arabica with varying doses of nitrogen and constant levels of phosphoric acid and potash.

6. Manurial demonstration plots laid out on robusta to demonstrate the effect of manuring with nitrogen alone and in combination with phosphoric acid and/or potash.

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Chemist.

IV. ENTOMOLOGY

The following fields of study were pursued by the Division of Entomology in the year reported:—

A. Survey on the seasonal intensity of incidence of pests of coffee—insects and nematodes.

B. *Applied Research.*—Observations on the chemical control experiments conducted in the laboratory as well as in the field at the Coffee Research Station, Balehonnur, and on those conducted under the auspices of the Proprietary Products Testing Scheme, Coffee Research Sub-station, Chethalli, Coorg.

C. *Basic Research.*—

(i) Laboratory and field studies on the habits and ecological relationships of various pests of coffee.

(ii) Recording the comparative abundance and activity of the parasite species of pests of coffee.

(iii) Collection, identification and preservation of insects obtained from various sources.

(iv) Examination of soil and plant samples for parasitic eelworms.

A. Survey on the Seasonal Intensity of Incidence of Pests of Coffee

The following pests of coffee received emphasis in the survey operations. They are arranged in the descending order of importance arbitrarily fixed for each:—

1.	Nematodes (Eelworms)	
2.	Shothole Borer	*Xyleborus morstatti* Hgdn.
3.	Red Borer	*Zeuzera coffeae* Nietn.
4.	Hairy Caterpillar spp.	*Eupterote canaraica* Moore *Eupterote fabia* Cram.
5.	Green Bug	*Coccus viridis* Gr.
6.	Mealy Bugs	*Pseudococcus citri* Riss. (root) *Planococcus* sp. (shoot)
7.	White Stem Borer	*Xylotrechus quadripes* Chev.

The incidence of nematode pests of coffee continued to attract major attention. Extended surveys combined with microscopic examinations of soil and plant samples threw light on the existence of more number of eelworm infected areas in various coffee zones. These areas included the following estates:—

(*a*)	Athoor	Suntikoppa, Coorg
(*b*)	Gubgul	Javali, Chikmagalur District
(*c*)	Golden Valley	Mudigere
(*d*)	Muskelmardi	Chikmagalur District
(*e*)	Nelloor Group	Suntikoppa, Coorg
(*f*)	Perumbucolly	Chethalli, Coorg
(*g*)	Yelemadloo	Koppa, Chikmagalur District
(*h*)	Murgadhae	do.
(*i*)	Kesinvurthy	Chikmagalur
(*j*)	Benhope	Nilgiris

In general, the incidence of shot hole borer was reported as low in the various zones. At Wynaad, North Kerala, this was about 1 per cent. while at Bankal, Javali and Khalasa areas in the Mudigere Zone, the incidence was moderate.

Monthly tracing operations in the estate at Coffee Research Station showed that the incidence of shot hole borer for the 1958–59 season (August 1958 to July 1959) was 16·57 per cent. less than the corresponding 1957–58 season. It may be seen in Appendix XLVII that a gradual increase in pest incidence which began in August reached a peak in December and later declined toward June–July.

Mild infestations of red borer were detected in a few young clearings at Bankal (Mudigere) in early 1959.

Independent and systematic tracing operations, from July 1958 to June 1959, at Coffee Research Station to detect red borer incidence, showed that the incidence was predominantly high in a few selected blocks. Appendix XLVIII shows that in the five selected blocks, peak incidence (4·48/acre) was reached in May 1959. Of the blocks, N.M.S.V. (2·06 acres) had the maximum degree of incidence (40·5/acre for the total period) while J, N.M.S. IV, L_2 seed and 1955 seed blocks followed in descending series (calculated at the rate of 1,030 plants/acre—$6\frac{1}{2}' \times 6\frac{1}{2}'$).

In the remaining blocks of the general estate also, the peak was reached in May but the total degree of incidence for the corresponding total period was 38·7 per cent. less than that in the aforesaid blocks (Appendix XLIX).

The incidence per acre in the whole estate for the above period is 3·13.

The incidence of hairy caterpillar species was rather severe at Chikli, Bagneheddal and Bynecool Estates on the Bababudan Giris, Chikmagalur. Of the species, *Eupterote fabia* Cram. was predominant. Young caterpillars, which appeared in July, engorged on the foliage of the preferred shade plants, Neeli (*Bischoffia javanica* Blume.), Nerale (*Eugenia jambolana* Lam.) and Dadap (*Erythrina* sp.) till September 1958. Attack on coffee by the migrating caterpillars commenced in November and lasted till January 1959. Due to the timely execution of various control measures, the damage during 1958–59 was less than that in the previous season.

Green bug infestation was reported to be severe during the middle of the year at Jamboor, Nagoor, Maccandur and Hosahally Estates in North Coorg, while appreciable infestation occurred also at Bynecool, Vasantcool and Kunmacci Estates in Chikmagalur during December 1958, January and June 1959. In Nilgiris, Shevroys and Pulneys, the pest population, in general, did not attain a major status except at Arcadia Estate, Yercaud.

Reports on the incidence of mealy bugs were received mainly from Kalpetta and Coorg.

Intervention of natural control agencies and timely adoption of accessory control measures, however, successfully checked the increased abundance of the above pest species in most of the zones.

The incidence of white stem borer did not cause much concern. The species assumed major status only in certain locations where preventive and protective operations were not properly undertaken. The incidence was perceptible on the lower elevations at Nilgiris, in several estates at Shevroys and Pulneys, in a few new clearings at North Coorg and on the East Bababudan Giris at Chikmagalur.

At Coffee Research Station, the incidence in the 1958–59 season was four as compared to 6 per acre in the 1957–58 season.

B. Applied Research—Laboratory and Field Experiments on the Chemical Control of Pests of Coffee

1. White Stem Borer—*Xylotrechus quadripes* Chev. (Coleoptera, Cerambycidae)

A trial to assess the comparative effectiveness of B.H.C., Dieldrin and Chlordane was in progress at Shegode Estate near the Coffee Research Station, Balehonnur.

New field trials with B.H.C. 50 per cent. W.P. (at 1·0 per cent. a.c.)—applied twice and thrice per year—, Dieldrin 50 per cent. W.P. (at 0·125 per cent. a.c.), Heptachlor 25 per cent. W.P. (at 0·1 per cent. a.c.) and Gusathion 20 E.C. (at 0·1 per cent. a.c.)—applied twice per year—have been started in various Liaison Zones during the middle of the year under the auspices of the Proprietary Products Testing Scheme. Most of these new trials replaced the older ones that existed in the different zones.

Experiment I. Trials with B.H.C., Dieldrin and Chlordane

Locality : Shegode Estate, Bolehonnur. *Started :* October, 1956.

Borer incidence in the experimental plots was negligible and hence only the following arbitrary comparison between treatments is attempted.

Dieldrex 18 E.C. (at 0·25 per cent. a.c.) when applied twice per year gave the lowest figure of borer incidence while Dieldrex (at 0·125 per cent. a.c.), Dieldrin 50 per cent. W.P. (at 0·25 per cent. a.c.) and B.H.C. 50 per cent. W.P. (at 1·0 per cent. a.c.), each applied thrice, showed degrees of effectiveness in the descending order.

The experiment is concluded.

The following table gives the locations of borer control experiments now in progress in various Liaison Zones:—

Zone/Estate	Started on	Lay-out
(i) Mudigere, Godhanda	October, 1958	Replicated–Randomized block design
(ii) North Coorg, Perumbucolly	August, 1958	do.
(iii) Saklespur, Belagode	August, 1958	do.
(iv) Mudigere, Baskal	May, 1956	Since discontinued
(v) Chikmagalur, Thogarihankal	October, 1956	
(vi) Nilgiris, Rockwood	May, 1956	

Depending upon the availability of areas suitable for experimentation, further trials would be laid out in due course.

2. Green Bug—*Coccus viridis* Gr. (Hem. Homoptera, Coccidæ)

Experiment I. Trials with Organophosphates

Locality : Arcadia Estate, Yercaud. *Started :* May, 1959.
Details : Treatments–9; Replications–5. *Plot size :* 1 plant with guard row around.
Lay-out : Randomized.

A spray trial as detailed above was started in Arcadia Estate to assess the degrees of effectiveness of various new proprietary formulations and compare these with Folidol, a standard recommended chemical.

Materials.—The names of the chemicals and the concentrations tried are given below.

	Materials		Active concentrations %	Rate/water oz. in gls.	
A.	Basudin 20% E.C.	Low. Conc.	0·03	15	60
		High Conc.	0·06	30	60
B.	Isochlorothion 50% E.C.	Low Conc.	0·05	10	60
		High Conc.	0·1	20	60
C.	Paramar 50% E.C.	Low Conc.	0·025	8	100
		High Conc.	0·05	16	100
D.	Fosferno 50% E.C.	Low Conc.	0·015	5	100
		High Conc.	0·03	10	100
E.	Gusathion 20% E.C.	Low Conc.	0·05	25	60
		High Conc.	0·1	50	60
F.	Folidol E-605 46·7% E.C.	Low Conc.	0·01	2	50
		High Conc.	0·02	4	50
G.	Meta-iso-systox 25% E.C.	Low Conc.	0·025	8	50
		High Conc.	0·05	16	50
H.	Ekatin 20% E.C.	Low Conc.	0·02	8	50
		High Conc.	0·04	16	50
I.	Control	No Treatment			

Note.—Low concentrations of all chemicals in one trial and high concentrations in another—Folidol being the standard for both the series.

The selection of concentrations of the above chemicals was primarily based on the concentrations of Folidol generally recommended for the control of green bug. The preliminary comparison so attempted is thought to provide scope for the selection and evaluation of further ranges of economically effective concentrations in the case of chemicals showing promise in the present experiment.

All plants in the experimental plot were aged about 10 years.

Methods

Altogether four observations were conducted, *viz.*, (1) initial (prior to treatment), (2) 15 days, (3) 25 days and (4) 35 days after treatment. At each of the

above periods of observations, counting of bug population was based on the following procedure. Three pairs of leaves carrying an almost uniform bug infestation were selected at random from each plant. The actual population of the bugs on a leaf (petiole, upper and lower surfaces) of the selected pair was counted and this was repeated for the remaining two pairs selected on the same plant and also for all those on other plants in the same as well as in other treatments. Thus 15 leaves were counted per treatment at each of the four periods of observations.

As far as possible, insect or fungus parasitized bugs were avoided in the initial counts and the exceptional cases of parasitism by insect or fungus that became evident during the post-treatment observations were separately recorded for additional information.

Analysis of Results

The results obtained 15 days and 25 days after treatment, in each concentration (low and high) tried, were statistically analysed; the analysis being primarily based on the percentage reduction in bug population obtained after treatment. A comparison between low and high concentrations of the chemicals at similar intervals is also attempted [Appendices L and L (*a*)].

Low Concentration—15 *Days after Treatment.*—It may be seen in Appendix L that Folidol, Gusathion, Fosferno and Paramar have been superior to the rest of the chemicals tried of which Meta-iso-systox and Basudin came next.

25 *Days After Treatment.*—As aforesaid, Gusathion, Folidol, Paramar and Fosferno continued to maintain their superiority over the rest at 25 days after treatment also. The degrees of effectiveness of Meta-iso-systox, Isochlorothion and Basudin were almost similar.

High Concentration—15 *Days after Treatment.*—Here again Fosferno, Folidol, Paramar and Gusathion maintained the highest degrees of toxicity. Meta-iso-systox was equally potent. The effectiveness of Ekatin was more perceptible here than at low concentration.

25 *Days after Treatment.*—At this interval, the former five chemicals retained their superiority in almost the same order as mentioned before while there was no significant difference between the degrees of effectiveness evidenced by Ekatin, Isochlorothion and Basudin.

Thus, at low and high concentrations, Folidol, Gusathion, Fosferno and Paramar were consistently effective to bring the highest percentage of reduction among bugs at 15 days and at 25 days after treatment. At high concentration, Meta-iso-systox was equally potent as the aforesaid chemicals at both the intervals of observations.

15 *Days Low* vs. 15 *Days High.*—Extended analysis and comparison in the above respect showed that there was no significant difference in the degrees of effectiveness between the high concentration of Fosferno, Folidol, Paramar,

Gusathion, Meta-iso-systox and the low concentration of Folidol and Gusathion [Appendix L (*a*)].

25 *Days Low* vs. 25 *Days High.*—As opposed to that which has been mentioned above, at low concentration, only Gusathion maintained significantly comparable effectiveness with high concentration of Fosferno, Gusathion, Paramar and Folidol. Further, there was no significant difference between the high concentration of Meta-iso-systox and low concentration of Gusathion and Folidol [Appendix L (*a*)].

From the above it appears that Gusathion, even at low concentration, has a prolonged duration of toxicity while low concentration of Folidol remains equally effective only at 15 days after treatment. Fosferno, Paramar and Meta-iso-systox show comparable potencies at 15 days and 25 days after treatment, at high concentration only.

3. Root Mealy Bug—*Pseudococcus citri* Riss. (Hem. Homoptera, Coccidæ)

Experiment I. Laboratory Studies on the Comparative Effectiveness of Systemic and Non-systemic Organophosphates

Locality : Coffee Research Sub-station, Chethalli. *Started :* January, 1959.
Details : Treatments–9; Replications–3; Bugs per Replication–15; *Lay-out :* Randomized.

A few series of qualitative tests making use of several new insecticidal formulations, as mentioned in the case of green bug, Experiment I, were conducted.

Materials

The concentrations of the chemicals tested are given below:—

Materials	Active concentrations	Rate/water oz.	in gls.
A. Fosferno 50% E.C. ..	Low conc. 0·015%	5	100
	High conc. 0·03%	10	100
B. Paramar 50% E.C. ..	L.C. 0·025%	8	100
	H.C. 0·05%	16	100
C. Basudin 20% E.C. ..	L.C. 0·03%	15	60
	H.C. 0·06%	30	60
D. Isochlorothion 50% E.C. ..	L.C. 0·05%	10	60
	H.C. 0·1%	20	60
E. Ekatin 20% E.C. ..	L.C. 0·02%	8	50
	H.C. 0·04%	16	50
F. Meta-iso-systox 25% E.C. ..	L.C. 0·025%	8	50
	H.C. 0·05%	16	50
G. Gusathion 20% E.C. ..	L.C. 0·05%	25	60
	H.C. 0·1%	50	60
H. Folidol E.-605 46·7% E.C. ..	L.C. 0·01%	2	50
	H.C. 0·02%	4	50
I. Control	Sprayed with distilled water		

Low and high concentrations tested in separate series.

Methods

The bugs attached to the roots of coffee (*C. arabica*) were gently removed by making use of a camel's hair brush. The specified number of bugs was released within petri dishes (10 cm. diameter) which had the inside of the bottom half covered with filter paper, Whatman-44. Only an empirical method was employed to apply the concentrations of the respective chemicals and this involved spraying known quantities (3 ml.) of an insecticidal solution by an atomizer on the bugs in the dish. Controls received only water spray. The cover of the petri dish was then inverted over the bottom leaving an uniform air space between them to avoid fumigant action of the chemicals, if any.

To avoid constant handling, the bugs were microscopically examined only *in situ*, at the intervals 4, 8, 24 and 48 hours after treatment. The results were recorded in the categories: normal, paralysed and dead bugs. The data were statistically analysed; the interpretations being based on the percentage mortality at 8 and 48 hours after treatment.

Analysis of Results

Low Concentration.—It may be seen in Appendix LI that at 8 and 48 hours after treatment, Basudin has been consistently superior to the rest to bring the highest degree of mortality. Also, the effectiveness of Folidol and Gusathion (8 hours after treatment) favourably compared with that of Basudin. At 48 hours after treatment, however, Ekatin, Paramar and Folidol showed similar degrees of toxicity comparable to Basudin.

High Concentration (Appendix LI).—The effectiveness (8 hours after treatment) at high concentration was pronounced in the case of Ekatin though there was no significant difference between this and that produced by Basudin, Gusathion and Folidol. At 48 hours after treatment, Basudin maintained the highest degree of toxicity as exhibited at low concentration while Gusathion, Fosferno, Ekatin, Folidol and Meta-iso-systox showed degrees of toxicity not significantly different from Basudin.

From the above it may be seen that Basudin at 0·03 and 0·06 per cent. is consistently superior to the other chemicals in effectiveness on the bugs in 48 hours after treatment. Its effectiveness is also perceptible at 8 hours after treatment in low and high concentrations with similar tendencies exhibited by Ekatin at the high concentration 0·04 per cent. as well as Folidol 0·01 and 0·02 per cent. and Gusathion 0·05 and 0·1 per cent.

Experiment II. Field Studies on the Comparative Effectiveness of Systemic and Non-systemic Organophosphates

Locality: Appee's Estate, Siddapur, S. Coorg. *Started:* February, 1959.

Details: Treatments—9. Replications—3. *Plot Size*—4 Plants. *Layout:* Randomized.

Based on the results obtained in the laboratory experiments, a filed experiment was laid out at Appee's Estate, Siddapur, South Coorg. The concentrations of

the chemicals used were the same as those in Experiment I. The plants included in the trial were S. 795 aged about two years, heavily infested with root mealy bugs.

Methods

The soil at the base of each plant was loosened to a depth of 4 to 6 inches and a basin of 9 inches radius was made which was then drenched with $\frac{1}{4}$ gal. of an insecticidal solution at a known concentration. Penetration of insecticides in each of the treatments was found to extend up to a depth of about 3 inches. The surface of application was then covered with a thin layer of soil. Observations on the comparative effectiveness of treatments at various intervals, *viz.*, 7 days, 10 days and 15 days after treatment, were primarily based on the relationship of the intensity of ant population, to that of bugs at and below the ground level to a depth of 2 inches. The following arbitrary standards were fixed to characterise the intensity of ant and bug population: (i) appreciable, (ii) moderate, (iii) poor and (iv) nil.

Analysis of Results

Low Concentration.—It may be seen in Appendix LII that throughout the periods of observations after treatment, plants treated with Basudin, Gusathion, Ekatin, Folidol and Fosferno were completely devoid of bugs. Ant movement in Basudin was poor, in Gusathion poor to moderate, in Ekatin and Folidol moderate to appreciable and in Fosferno appreciable throughout the periods of observations. In Basudin and Gusathion, appreciable ant movement without reinfestation of bugs in the two inch layer below the surface was observed within a month following treatment and after the above periods of observations, while, in Ekatin, Folidol and Fosferno, in the aforesaid interval, appreciable ant movement and reinfestation by bugs were noticed.

In Paramar, Isochlorothion and Meta-iso-systox, the reduction in ant movement and bug population was not as significant as in the case of the former chemicals and a large-scale reinfestation of bugs was apparent in a majority of the treated plants within a month following treatment and after the aforesaid periods of observations.

High Concentration.—Observations on the effects of high concentration of Basudin, Gusathion, Ekatin, Folidol and Fosferno for the 15 days following treatment were, in general, similar to those obtained for the low concentration, though ant movement was definitely poor in Basudin as well as in Gusathion, poor to moderate in Ekatin, moderate in Folidol and moderate to appreciable in Fosferno during the periods of observations. Further observations following the 15 days after the treatment were in conformity with those for low concentration.

As opposed to the above, Paramar and Meta-iso-systox did not bring in comparable reduction in the bug and ant population. In the case of Isochlorothion, bugs were present throughout the periods of observations.

It is apparent from the above observations that Basudin and Gusathion at either concentrations are equally and more effective to control the pest species

for a longer duration than Ekatin, Folidol and Fosferno. The degrees of effectiveness of Paramar, Isochlorothion in either concentrations are much less significant.

It is hoped that extended trials with the above chemicals and Malathion, to be started in the oncoming season, 1959–60, would help to arrive at definite conclusions in context to future recommendations on root mealy bug control.

4. Shot Hole Borer—*Xyleborus morstatti* Hgdn. (Coleoptera, Scolytidæ)

Experiment I. Spray Trials with Gusathion, B.H.C., Fosferno and Folidol

Locality : L_1 Valley, Coffee Research Station, Balehonnur. *Started :* November, 1958.
Details : Treatments–5; Replications–5. Plot size–2 plants with guard rows around.

The comparative effectiveness of Gusathion 20 per cent. E.C. (at 0·1 per cent. a.c.), B.H.C. 50 per cent. W.P. (at 0·5 per cent. a.c.), Fosferno 50 per cent. E.C. (at 0·05 per cent. a.c.) and Folidol E–605 (at 0·01 per cent. a.c.) to control the pest species was assessed.

Methods

Initial infestation counts were taken in November 1958. For this purpose, 50 twigs from each plant were selected at random and were examined for infestation by splitting them open. Soon thereafter, treatments were imposed. Subsequent observations were made at monthly intervals till March 1959. Immediately after the first post-treatment observation (December 1958), one of the two treated plants in each plot was given a second spray with the respective chemical. This was aimed at to compare the effectiveness of one application with two applications of a chemical.

Results

The results obtained for both the categories of applications did not show conclusive evidences on effective pest control by any of the chemicals. In December, the month following initial treatment, all plants showed percentages of infestations higher than the initial, while, in January 1959, only plants treated twice with Gusathion showed pest incidence reduction by 10 per cent. from the initial (November 1958). This is in comparison with a 4·1 per cent. increase in pest incidence on plants in the same treatment which received only one spray.

It now seems apparent that the chemicals employed would not be of much use to control the pest species economically. The comparative effectiveness of the chemicals would have been best known during November and December—the peak period of infestation at Coffee Research Station. However, in this period, the results, as discussed above, have been unsatisfactory. Perhaps executing more series of applications at shorter intervals and/or selection of higher concentrations of the chemicals would give further evidences. In this connection, it has to be

mentioned that B.H.C. at 1·0 per cent. a.c. was already found to afford a certain degree of protection to the plants during the first two months following initial treatment (Annual Report, 1957–58).

The present experiment is discontinued.

Experiment II. Spray Trials with the Systemics, Meta-iso-systox and Ekatin

Locality : L_1 Valley, Coffee Research Station, Balehonnur. *Started:* December, 1958.
Details: Treatments–3; Replications–3. Plot size–2 plants with guard rows around.

Earlier experiments with Metasystox and Ekatin by the " banding method " did not prove successful to bring significant reduction in pest incidence. To study the effect of the chemicals—sprayed to the foliage—on pest incidence, a small-scale exploratory field trial was undertaken at the Coffee Research Station. The concentrations of the chemicals tried were : (*a*) Meta-iso-systox 25 per cent. E.C. (at 0·1 per cent. a.c.) and (*b*) Ekatin 20 per cent. E.C. (at 0·04 per cent. a.c.).

Methods

Initial infestation counts as for Expt. I were recorded just prior to treatment in December, 1958 and, subsequently, four post-treatment observations were also carried out at monthly intervals till April 1959. Soon after the first post-treatment observation (January, 1959), one plant in each plot was given a second spray with the respective chemical. The data (Appendix LIII) of the following recordings on the percentage reduction in pest incidence were statistically analysed.

(i) January, 1959 .. One month after initial ; on all plants.

(ii) February, 1959 .. Two months after initial ; on one plant in each plot—one application in December, 1958.

(iii) February, 1959 .. Two months after initial ; on one plant in each plot—one application in December and another in January.

The results are separately discussed below.

(*i*) *January*, 1959. *One month after initial on all plants treated in December*, 1958.—The treatments were significant. Meta-iso-systox (at 0·1 per cent. a.c.) effected the maximum degree of control on pest incidence while that effected by Ekatin was not significantly different. Both the above treatments were superior to control.

(*ii*) *February*, 1959. *Two months after initial on one plant in each plot treated in December*, 1958.—The treatments were not significant. It may be apparent that one application of either chemical was not sufficient enough to exercise control on the pest species beyond a period of about a month.

(*iii*) *February*, 1959. *Two months after initial on one plant in each plot treated in December*, 1958 *and again in January*, 1959.—As opposed to the above (ii) it was

seen that a renewed application of Ekatin, at a month's interval, was significantly superior to Meta-iso-systox notwithstanding the fact that the latter chemical was equally effective in (i).

Since the above systemics have shown some degree of promise, extended field trials using a series of equitoxic concentrations are to be started at the Coffee Research Station, and in a few liaison zones as soon as the pest species regains activity. Critical survey to the latter end is being conducted in the North Kerala liaison zone where the incidence is often reported to be higher than in others.

5. Hairy Caterpillar—*Eupterote fabia* Cram. (Lepidoptera, Eupterotidæ)

The renewed seasonal incidence of species of hairy caterpillars at various estates on the Bababudan Giris, Chikmagalur, necessitated the conduct of several series of chemical control trials in the laboratory and in the field. Many of the chemicals in these "sorting tests" were proprietary formulations experimented on the pest species for the first time. The nature of the trials was mainly qualitative and the selection of concentrations (high and low) of the new formulations tried was based primarily on the recommended concentrations of other standard chemicals such as Folidol and B.H.C. widely used in coffee plantations.

Experiment I. Effect of Chemicals on the IV, V and VI Instar Caterpillars

Locality : Coffee Research Station, Balehonnur. *Started :* October, 1958.

Materials

Large number of caterpillars, collected from Chikli Estate, were cultured on dadap leaves kept in cages at the Coffee Research Station. The trial was run on caterpillars of the IV, V and VI instars in independent series and in each series, the test population consisted of caterpillars solely of one instar. However, depending upon the availability of the required number of caterpillars of a specific instar for a series, the instars used for the different series varied as follows.

Laboratory Trial	Series I	(high concentration)	IV Instar
	,, II	(do.)	V ,,
	,, III	(low concentration)	VI ,,
Field Trial	,, I	(high concentration)	IV ,,
	,, II	(low concentration)	VI ,,

The field trials included controlled studies in cages at the Coffee Research Station and a mass-scale shade spray operation on young caterpillars (IV and V instars) found on dadaps at Chikli Estate, Chikmagalur.

The chemicals tried were Folidol E-605 (0·01 per cent. a.c. and 0·005 per cent. a.c.), D.D.T. 50 per cent. W.P. (0·15 per cent. a.c. and 0·1 per cent. a.c.), Dieldrex 18 per cent. E.C. (0·05 per cent. a.c. and 0·025 per cent. a.c.), Chlordane 75 per cent. E.C. (0·09 per cent. a.c. and 0·045 per cent. a.c.), B.H.C. 50 per cent. W.P. (0·25 per cent. a.c. and 0·125 per cent. a.c.), Heptachlor 25 per cent. W.P.

(0·06 per cent. a.c. and 0·03 per cent. a.c.), Malathion 50 per cent. E.C. (0·05 per cent. a.c. and 0·025 per cent. a.c.), Dipterex 50 per cent. E.C. (0·1 per cent. a.c.) and Basudin 20 per cent. E.C. (0·01 per cent. a.c. and 0·005 per cent. a.c.).

Methods

Laboratory.—Each series of trials in the laboratory consisted of three replications for a treatment ; each replicate of 10 caterpillars of a specific instar. The caterpillars were released on severed coffee twigs the cut ends of which were kept in contact with water. The empirical method adopted to apply the diluted insecticides involved spraying approximately 10 ml. of a chemical on the caterpillars by an atomizer. The caterpillars were then kept enclosed in belljars with sufficient open space provided on the top and at the base of the jars to allow the fumes of the chemicals, if any, to escape. Controls received only water spray. The number of dead, paralysed and normal caterpillars was recorded at the intervals 4, 8 and 24 hours after treatment. The observations in each series were statistically analysed on the basis of death produced by each chemical at 4 and 8 hours after treatment.

Field.—The series of field trials were nonreplicated. The total number of caterpillars used per treatment was 50. These were released on plants kept enclosed in a wirenet cage of $4' \times 2\frac{1}{2}' \times 4'$ dimensions and were then subjected to the imposition of treatments by making use of a compressed air sprayer. Soon thereafter, the top of each cage was covered with a wirenet. Only one observation for each series was conducted, namely, 72 hours after treatment for series I and 48 hours after for series II. The data were recorded as aforesaid.

Analysis of Results (Appendix LIV)

(*a*) *Laboratory—Series I. Effects of High Concentration on the IV Instar Caterpillars—4 hours after treatment.*—It may be seen that Dipterex (0·1 per cent.), Dieldrex (0·05 per cent.), Malathion (0·05 per cent.) and Folidol (0·01 per cent.) were equally potent while B.H.C. (0·25 per cent.) as well as Heptachlor (0·06 per cent.) were comparable to Malathion and Folidol. Chlordane (0·09 per cent.) and D.D.T. (0·15 per cent.) were inferior though there was no significant difference in the mortalities procured between these and Heptachlor.

8 *Hours after treatment.*—At this interval, Dipterex, Dieldrex, Folidol, D.D.T., B.H.C. and Malathion showed degrees of toxicities not significantly different from each other. The effectiveness of Heptacholor was not significantly different from that of the latter four chemiclas in the first group.

It is obvious that D.D.T. and B.H.C. showed increased toxicities at this interval while such a tendency was absent in the case of Heptachlor and Chlordane.

Laboratory—Series II. Effect of High Concentration on the V Instar Caterpillars–4 Hours after treatment.—As opposed to the above observations, the comparative effectiveness of the concentrations of chemicals showed sharp demarcations. The effectiveness of Folidol was significantly superior to the three of the remaining chemicals, Basudin (0·01 per cent.), Malathion and Dieldrex, which came next.

Further, there was no significant difference in effectiveness between Dieldrex and B.H.C. as also between the latter, Heptachlor and D.D.T.

8 *Hours after treatment.*—In contrast to that observed at 4 hours after treatment, the degrees of effectiveness of Dieldrex and Basudin were *on a par* with Folidol and there was no significant difference in effectiveness between the former two, B.H.C. and D.D.T. The effectiveness of Basudin was not significantly different from that of Malathion. Heptachlor and Chlordane, as in the Series I, were inferior.

Laboratory—Series III. Effect of Low Concentration on the VI Instar (Migrating) Caterpillars—4 Hours after treatment.—As in Series II, the effect of Folidol (0·005 per cent.) was significantly superior to Dieldrex (0·025 per cent.), Malathion (0·025 per cent.) and Basudin (0·005 per cent.).

8 *Hours after treatment.*—The degrees of effectiveness of Dieldrex, Folidol, Malathion, B.H.C. (0·125 per cent.), D.D.T. (0·1 per cent.) and Basudin were not significantly different from each other and were superior to the remaining chemicals, *viz.*, Chlordane and Heptachlor, which were much less effective.

(*b*) *Field—Series I. Effect of High Concentration on the IV Instar Caterpillars.*—Observations at 72 hours after treatment showed that all the chemicals, as tried in Laboratory—Series I, could effect 100 per cent. mortality in the pest population. In control, the mortality was 2 per cent. in the above period.

Field—Series II. Effect of Low Concentration on the VI Instar Caterpillars.—

The results were, in general, in conformity with those of Laboratory—Series III. Folidol, D.D.T. and Dieldrex effected 100 per cent. mortality among the pest population in 48 hours after treatment.

From the above, the following generalizations are drawn: (i) On the IV instar caterpillars, high concentration of Dipterex, Dieldrex, Malathion and Folidol are superior to the rest, at 4 hours after treatment, while, at 8 hours after, D.D.T. and B.H.C. are as potent as the former. (ii) On the V instar, high concentration of Folidol is superior to Basudin, Malathion and Dieldrex at 4 hours after treatment, while, at 8 hours after, all the above except Malathion are equally toxic. The degrees of effectiveness of B.H.C. and D.D.T. at 8 hours after treatment are not significantly different from those of Dieldrex and Basudin. (iii) On the VI instar at 4 hours after treatment, low concentration of Folidol—as in the case of high concentration on the V instar—is definitely superior to Dieldrex, Malathion and Basudin. At 8 hours after, all the above along with B.H.C. and D.D.T. show potencies of a similar degree.

Correlating the results of laboratory and field observations in context to economics, it may be seen that Folidol or B.H.C. could be the ideal insecticides to combat the early instar caterpillars seen on dadap and on other low level shade during September, while D.D.T. or Diledrex would be preferable to check the migratory ones. The choice of either of the latter two in preference to Folidol, during the latter phase, is made on the basis of longer duration in residual action warranted

at the beginning of the migratory phase. In late season (December), when the caterpillars congregate at the bases of coffee and other shade trees, high concentration of Folidol applied to the various loci would be more economical. Late season application of B.H.C. to the bushes, just prior to harvest, could bring in the problem of tainting the berries.

Further trials using ranges of equitoxic concentrations of various chemicals are contemplated for the oncoming season 1959–60.

Experiment II. Bulk Spray at Chikli Estate, Chikmagalur

As already mentioned, in October 1958, a mass scale spray operation with Folidol (0·01 per cent. a.c.), B.H.C. (0·25 per cent. a.c.) and D.D.T. (0·15 per cent. a.c.) was adopted at Chikli Estate, Chikmagalur, to control the IV and V instar caterpillars found on dadaps 30′ tall. Observations, the day following treatments, showed that the chemicals effected appreciable control of the species and a majority of the treated plants bore dead and paralysed caterpillars. The success of this operation was so encouraging that the programme of spraying to the shade was undertaken and continued by several planters in the area. This in its wake, during the 1958–59 season, considerably minimized the extent of damage done to coffee by the migrating and advanced caterpillars in October–January. Based on the above, a schedule of operations has been established for the forthcoming seasons.

The utility of applying mist and fog through " Swing fog " to control the caterpillars on various levels of shade is to be assessed in the oncoming season.

Experiment III. Effect of the Organophosphates, Paramar, Fosferno, Gusathion and Malathion on the VII Instar Caterpillars

Locality : Coffee Research Station, Balehonnur. *Started :* December, 1958.
Details : Treatments—5; Replications—3; Caterpillars per replication—10.

A small-scale preliminary trial with Paramar 50 per cent. E.C. (at 0·05 per cent. a.c.), Fosferno 50 per cent. E.C. (at 0·03 per cent. a.c.), Gusathion 20 per cent. E.C. (at 0·1 per cent. a.c.) and Malathion 50 per cent. E.C. (at 0·15 per cent. a.c.) was conducted in the laboratory on the VII instar caterpillars of *E. fabia*. The methods of observation adopted were similar to those in Expt. 1—Laboratory Series. Data on the degrees of mortalities produced at 24 hours after treatment were statistically analysed (Appendix LV).

Analysis of Results

It may be seen in the Appendix that Paramar and Gusathion were superior to Fosferno and Malathion at the concentrations tested. Further trials using ranges of equitoxic concentrations of various chemicals are contemplated.

6. Eelworms

Experiment I. Trials with Nemagon.

Locality: Ossoor and Belagode Estates, Saklespur. *Started:* April, 1957.

Details: Treatments—2; (A) Control, (B) Nemagon ("Shell" Product); Replications—10 in each Estate; Plot size—2 plants; Lay-out—randomized.

Method

Diluted solution of Nemagon at 0·05 per cent. (1 gallon in 2,000 gallons of water) was applied at the rate of 8 gallons to a basin of 3′ diameter around each plant preceded by initial soil sample collections, for eelworm estimations, from the depths 0–9″, 9–18″ and 18–27″. Further collections from the above depths were made in the following periods:—

(1) 2 Months after treatment .. June, 1957
(2) 6 to 7 Months after treatment October–November, 1957
(3) 12 Months after treatment .. April, 1958
(4) 14 Months after treatment .. June, 1958
(5) 18 Months after treatment .. October, 1958

Analysis of Results [Appendices LVI, LVI (*a*), LVI (*b*), LVI (*c*)]

Ossoor Estate.—The depths were significant at both levels. The depth 0–9″ showed high nematode counts (parasites only) in both control (A) and Nemagon (B). The month, June 1958, showed significantly higher counts than the rest. Treatments were significant at both levels, wherein (A) exhibited significantly higher counts than (B).

The effectiveness of the chemical was best seen between June 1957 (two months after treatment when the chemical is reported to begin exerting its action) and November 1957. This effectiveness was pronounced at the depth 9–18″ as given below.

Percentage increase or decrease in eelworm population from June 1957 to November 1957 in three depths of A and B

	0–9″	9–18″	18–27″
A. Control	21·4%+	36·5%+	12·5%+
B. Nemagon	22·5%−	46·6%−	14·2%−

+, increase; −, decrease.

The lower counts for April 1958 would have been promoted by a comparatively dry period following November 1957. This was supported by the fact that in June 1958, there was noticed an enormous increase in the population—peak infestation. Perhaps, a renewed application sometime between November 1957 and April 1958 would have exerted further control on eelworms.

The plant condition did not, however, show much improvement in the above period of effectiveness but a tendency toward improvement was perceptible when the trial was concluded. How long this tendency would be sustained, remains to be seen.

Belagode Estate.—In this experiment, neither a trend towards eelworm population reduction nor improvement in plant condition could be noticed. The treatments were not statistically significant.

The above experiment is concluded.

Experiment II. Trials with Nemagon, V.C. 13 Nemacide, Soil Amendments, Farmyard Manure and Vapam

Locality : Wooligooly Estate, North Coorg. *Started :* October, 1958.

Details : Treatments—6; Replications—5; Plot size—144 sq.ft. holding 4 plants with guard rows and deep trenches around; Lay-out—randomized.

The treatments are as follows:—

A.	Control ..	Normal estate practice of manuring, NPK (60:90:70 applied twice).
B.	Farmyard manure (decomposed cattle manure)	Normal estate practice of manuring + Farmyard manure at 20 tons per acre, *i.e.*, 40 lb. per plant.
C.	Soil amendment ..	(1) Sulphur at 1 cwt. per acre. (2) Urea to give 100 lb. N per acre or 178 lb. urea (45% N) per acre. (3) Calcium cyanamide (20–21% N) 100 lb. per acre (20 lb. N per acre) + Normal estate practice of manuring.
D.	Nemagon ..	10 gms. per acre.
E.	Vapam ..	5½ gms. per acre.
F.	V.C. 13 Nemacide ..	10 gms. per acre.

Method

Treatments as detailed above were imposed in October 1958. The required quantity of a nematicide calculated for an area of 144 sq. ft. was diluted with 12 gallons of water and the soil in the drip circle area of plants in a plot was uniformly drenched.

Initial as well as post-treatment soil sample collections for eelworm estimation are made at two depths, 0–12″ and 12–24″, from the drip circle area of each of the four plants in a plot. The soil from similar depths are then thoroughly mixed. From each of the above two mixtures, a random sample (50 gm.) is taken for examination. This procedure is followed for all the remaining plots.

The periods of soil sampling as well as observations on plant growth condition are as follows:—

(1) Initial	observation—prior to treatment ..	October, 1958
(2) Second	,, ..	December, 1958
(3) Third	,, ..	February, 1959
(4) Fourth	,, ..	April, 1959
(5) Fifth	,, ..	September, 1959
(6) Sixth	,, ..	November, 1959
(7) Seventh	,, ..	January, 1960
(8) Eighth	,, ..	March, 1960
(9) Ninth	,, ..	May, 1960
(10) Tenth	,, ..	October, 1960

The eelworms detected are classified in the categories, parasites, predators and free living.

The experiment is in progress.

C. Basic Research

1. Laboratory and Field Studies on the Habits and Ecological Relationships of Various Pests of Coffee

(*a*) **Hairy Caterpillar, *E. fabia*.**—The following table shows the duration of each stage in the lifecycle of *E. fabia*. The observations were conducted in the laboratory at Coffee Research Station, Balehonnur.

Life-History of *E. fabia*

Stage	Average duration (days)	Range (days)	Average temperature° C.	Average rel. hum.	Maximum temperature	Minimum temperature
Egg	20	15–25	22·6	86·24	25·0	21·1
Larva I instar	6	5– 7	22·6	86·24	25·0	21·1
II instar	13	12–17	23·4	81·82	25·6	20·0
III instar	11·6	11–13	23·2	82·19	26·6	21·1
IV instar	15·5	14–17	24·2	81·30	26·7	21·7
V instar	18·8	15–24	24·1	74·26	26·7	20·6
VI instar	23·6	20–26	23·1	74·45	25·6	20·6
VII instar	23·7	18–26	22·9	65·61	25·6	20·0
VIII instar	35·6	29–43	24·0	62·10	26·7	19·4
IX instar	40	36–44	25·3	56·24	28·9	20·0
Pupa	144·6	122–160	25·3	72·6	31·7	19·4
Adult	3·6	3–4	20·8	93·4	23·1	18·6

Moths began oviposition 12–14 hours after emergence. The number of eggs laid ranged from 200–250.

(*b*) **Red Borer, *Z. coffeæ*.**—Independent tracing for the red borer commenced in July 1958 at Coffee Research Station aims at studying the life-history of the species. The larvæ collected from various blocks are preserved and await sorting, identification and detailed morphological studies.

2. Studies on the Abundance and Activity of Parasites of Pests of Coffee

(*a*) **Green Bug, *C. viridis*.**—The following parasite species were recorded in the field during various periods.

F. Eulophidæ .. *Coccophagus bogoriensis* Köening. *Tetrastichus lecanii* (Grlt.) (not *T. lecanii* Ashmead).

F. Encyrtidæ .. *Cheiloneuromyia javensis* Grlt. *Cheiloneurus* sp.

Of the above, *C. bogoriensis* and *C. javensis* were more abundant than the rest.

(*b*) **Hairy Caterpillars, *E. fabia* and *E. canaraica***

The list of recorded parasite species is given below.

(1) Braconidæ—*Apanteles* spp.

(2) Tachinidæ—Gen. *et* sp. not determined.

(3) Not identified—egg parasite.

(4) Fungus—*Beauveria bassiana*.

The incidence of *Apanteles* spp. was perceptible to a great extent in various estates in the Bababudan Giris. Parasitism was mostly confined to the late instars and many of the caterpillars of both the species that had descended into the mulch showed characteristic cocoons of the parasite species on their bodies. In the laboratory, the larval stage of the species extended for about two weeks while the pupal stage about a week. A caterpillar was found to harbour as many as 50 parasite larvæ.

A species of tachinid parasite was found to parasitize the caterpillars (*E. canaraica*) at Merthikhan Estate near Balehonnur. A single host caterpillar contained five to seven parasite larvæ. Pupation took place within the larval skin (puparium) in the carcass of the host caterpillar.

The incidence of an unidentified egg parasite (Hymenoptera) was observed in a few cases near Bynecool Estate, Chikmagalur.

The parasitic fungus, *Beauveria bassiana*, was active in various degrees ; the incidence being perceptible from the IV instar larvæ of both the species of hairy caterpillars.

(*c*) **Leaf Miner, *Agromyza* (*Melanagromyza*) *coffeæ*. Hering.**—Two eulophid parasites, *Coccophagus* sp. and *Closterocerus* sp., were recorded.

3. Collection, Identification and Preservation of Insects obtained from Various Sources

Several specimens of insects collected mainly from the light traps instituted in J and N.M.S. V blocks at Coffee Research Station, Balehonnur, were preserved and many of them were identified up to families . The collections were commenced in January 1959 and the following table shows the number of specimens collected up to the 23rd March 1959.

Order	J-Block	N.M.S. V
Orthoptera ..	98	106
Dermaptera ..	23	21
Hem. Heteroptera ..	70	108
Hem. Homoptera ..	726	585
Coleoptera ..	317	384
Lepidoptera ..	880	1049
Hymenoptera ..	598	654
Diptera ..	963	659
Trichoptera ..	13	54
Isoptera ..	419	155
Odonata ..	2	0
Plecoptera ..	0	0
Neuroptera ..	0	1
Psocoptera ..	1	2
Total ..	4110	3778

A permanent trap has been in operation at N.M.S. V block to study the effect of light intensity and the height of light source on the catches of insects. These observations are in progress.

The above experiment aims at also to determine the insect fauna in the estate at Coffee Research Station, Balehonnur.

4. Studies on Eelworms—Distribution

The species of eelworms detected and identified earlier (Annual Report, 1957–58) were located in many more coffee estates as tabulated below.

Distribution of species of parasitic eelworms in coffee estates, 1958–59

Eelworms / Estates	*Radopholus similis*	*Tylencho-rhynchus* sp.	*Xiphinema indicum*	*Pratylenchus* sp.	Other forms
1. Athoor, Suntikoppa, Coorg	Nil	Yes	Nil	Nil	Yes
2. Gubgul, Javali, Mysore State	Yes	Yes	Nil	Nil	Yes
3. Golden valley, Mudigere, Mysore State	Yes ?	Nil	Nil	Nil	Yes
4. Muskulmardi, Chik-magalur	Yes ?	Yes ?	Nil	Nil	Yes
5. Nelloor, Suntikoppa	Nil	Yes ?	Nil	Nil	Yes
6. Perumbocolly, Coorg	Yes	Nil	Nil	Nil	Yes
7. Yelemadloo, Koppa, Mysore State	Nil	Yes	Nil	Nil	Yes
8. Murgadhae, Koppa, Mysore State	Nil	Yes	Nil	Nil	Yes
9. Kesinvurthy, Chik-magalur	Nil	Yes	Nil	Nil	Yes
10. Benhope, Nilgiris	Nil	Yes	Nil	Nil	Yes

It may be seen that *Tylenchorhynchus* sp. predominated in the identifications. The predators included *Mononchus* sp. The free living forms, *Cephalobus* sp. and *Rhabditis* sp., were abundant in most of the samples examined.

P. SOMASEKHAR.
Entomologist.

V. MYCOLOGY

Studies on the life-histories of the causative agencies of the important diseases affecting coffee, their incidence, periodicity and effective field control formed the main work of this Division.

The field trials comparing proprietary formulations with Bordeaux mixture regarding efficacy of control of leaf disease were continued. The possibilities of effecting economy in spraying costs are being started through different methods of spray application. The studies on nursery and post-nursery diseases were continued.

A. Studies on the Control of Leaf Disease Caused by *Hemileia vastatrix*—Disease Control through Fungicidal Sprays

(*a*) Comparison of proprietary fungicides with Bordeaux mixture—Field trials at Coffee Research Station, Balehonnur

Trial 1 : *Experiment to Compare Proprietary Fungicides with Bordeaux Mixture.*—This trial started during 1956 pre-monsoon period was continued. Post and pre-monsoon sprays with the different chemicals were applied during September 1958 and May 1959. Observations on the percentage of leaf survival in the different treatments are summarised in Appendix LVII.

During February 1959 counts, no significant differences between treatments were observed. In September 1958 observation, treatments H, I and G (Bordeaux with stickers and plain) were significantly superior over the other treatments. Treatments J and F (unsprayed control and Ultrasulphur) showed the poorest leaf retention. Similar results were obtained in the previous observations also, right from the start of the trial. Considering the data from the start of the trial, it is also noticed that except in one case, no significant differences were noticed between plain Bordeaux mixture and Bordeaux with stickers. The experiment is concluded and discontinued.

Trial 2: *Experiment to Compare the Efficacy of Blitox Ipsilon with Bordeaux Mixture.*—This trial started in June 1956 was continued. Spray applications were given in September 1958 and May 1959. Leaf counts were recorded in September 1958 and February 1959. The data are summarized in Appendix LVIII.

No significant differences were noticed between treatments both during September 1958 and February 1959 observations. Similar trends were noticed in previous observations also, except during September 1957 when treatment G (Bordeaux mixture at 400 gls./acre) showed superiority over treatments I, F, D, E, B and H. The trial is concluded and discontinued.

Trial 3: *Experiment to Compare Proprietary Fungicides and* 2 : 4-*D with Bordeaux Mixture.*—This exploratory trial started during 1956 post-monsoon was continued. Spray applications with the different formulations were given as per schedule. Details of assessment of disease incidence recorded in the different treatments are furnished in the following table:—

Symbol	Treatments	Initial	Mean percentage of leaves				
		Nov. 1956	July 1957	Sept. 1957	July 1958	Sept. 1958	July 1959
A	Kirticopper 1 lb. in 40 glns.	70·60	42·69	82·19	41·45	89·4	36·6
B	Flit 406 0·2%	61·70	58·60	88·39	39·28	85·2	49·2
C	Flit 406 0·4%	67·20	65·47	80·90	39·27	90·1	60·3
D	Bordeaux 0·5%	71·80	37·21	78·49	39·31	89·1	19·5
E	2 : 4-D 8 p.p.m.	68·50	66·73	90·00	64·17	93·4	48·8
F	Control—unsprayed	74·50	89·71	87·84	71·29	90·2	54·7

Bordeaux-sprayed plots showed the minimum disease incidence consistently. Unsprayed control and 2: 4-D-sprayed plots showed high disease incidence throughout. In the case of 2: 4-D treatment, the plants continued to show phytotoxicity. The trial is concluded and discontinued.

Trial 4: *Experiment to Compare New Proprietary Fungicides with Bordeaux Mixture.*—This experiment started in May 1957 was continued. The different treatments were imposed as per programme. Observations on effective percentage of leaf survival and disease counts recorded in the different treatments are summarized in Appendix LIX.

During September 1958 observation, all the sprayed treatments were *on par* between themselves, but were superior to unsprayed control. In February 1959 counts, no significant differences were noticed, though numerically, unsprayed control plots continued to show the minimum leaf retention. Observations on disease incidence also showed similar trends.

Trial 5: *Spray Experiment to Compare the Efficacy of Eradicant Fungicide* O–3818–B *with Bordeaux Mixture.*—This trial was started during the pre-monsoon period of 1959 to find out the efficacy of a new eradicant fungicide in controlling leaf disease of coffee as compared with the standard 0·5% Bordeaux mixture. The details of the trial are given below:—

Locality.—Coffee Research Station, Balehonnur.

Year of Start.—May 1959.

Treatments.—

(A) Unsprayed Control

(B) Eradicant Fungicide O–3818–B ..	0·35%	}	4 sprays an year.
(C) do. ..	0·175%	}	
(D) Bordeaux Mixture	0·5%		2 sprays an year.

Replications.—4.

Lay-out.—Latin square design.

Plot Size: Gross: 4×4=16 plants. Net: 2×2=4 plants.

Results are awaited.

(*b*) Comparison of proprietary fungicides with Bordeaux Mixture—Field trials at Coffee Research Sub-station, Chethalli

Trial 6: *Experiment to Compare New Proprietary Fungicides with Bordeaux Mixture.*—This trial started in May 1957 was continued. Post and pre-monsoon spray applications have been given as per schedule. The effective percentage of leaf survival recorded in the different treatments is furnished in Appendix LX.

No significant differences are noticed between treatments both in September 1958 and February 1959 observations.

Trial 7: *Comparison of Proprietary Fungicides with Bordeaux Mixture.*— This trial started in May 1958 to find out the efficacy of certain fungicides (based on copper as well as of an organic nature), as compared with standard 0·5 per cent. Bordeaux mixture in controlling leaf disease of coffee, was continued. The scheduled post- and pre-monsoon sprays with the different chemicals have been applied. Observations on the effective percentage of leaf survival recorded during September 1958 and February 1959 are furnished in Appendix LXI.

No significant differences between treatments are noticed both in September 1958 and February 1959 observations. Dithane M-22 (4 sprays per year) and Bordeaux mixture with Triton X-114 sticker gave numerically better leaf retention than other treatments.

General Conclusions on Spray Trials Comparing Bordeaux Mixture with Proprietary Fungicides for Controlling Leaf Disease of Coffee

Fourteen different proprietary fungicidal formulations (including stickers) based on copper, mercury, sulphur and of an organic nature, in different concentrations were compared with Bordeaux mixture to find out their relative efficacy in controlling leaf disease of coffee. The results from these trials continue to show the same trends as obtained in previous years, *viz.*, that none of these proprietary formulations tested have so far given a consistently significant superior control of leaf disease over that afforded by the present standard 0·5 per cent. Bordeaux mixture.

(*c*) Comparison of proprietary fungicides with Bordeaux Mixture—Field trials in different Liaison Zones, under the proprietary products testing scheme

A special project called the P.P.T. Scheme has been instituted to test various proprietary formulations to find out their comparative effectiveness for use in coffee. Under this scheme extensive field trials in the different coffee zones are being laid out to get a comprehensive picture of the effectiveness and economics of the use of such formulations.

The scheme has started functioning from August 1958. A general survey of the different coffee zones was taken up to find out the disease position in these zones, in order to select plots for laying out field trials to test the comparative efficacy of various fungicidal formulations for control of leaf disease of coffee.

Four statistically laid out field trials comparing eight different proprietary formulations have been started in different coffee zones, during 1958 post-monsoon period for finding out their comparative efficacy in controlling leaf disease of coffee. Two more trials have been started during 1959 pre-monsoon period. These trials have been so laid out that each formulation is tested under both South-West and North-East conditions. The details of the trials laid out are furnished below. Results are awaited.

Trial 8:

Locality.—Woodlands Estate, Kulakambi, Coonoor.

Year of Start.—1958 post-monsoon.

Treatments.—

(A) Cupricol.
(B) Kirticopper.
(C) Microcop.
(D) Bordeaux Mixture.

Replications.—4.

Lay-out.—Randomized.

Plot Size.—Gross: 20×5=100 plants. Net: 18×3=54 plants.

Trial 9:

Locality.—Pillavali Estate, Pattiveeranpatty.

Year of Start.—1958 post-monsoon.

Treatments.—

(A) Bordeaux Mixture + Tenac Sticker.
(B) Cobredon.
(C) Bordeaux Mixture.

Replications.—4.

Lay-out.—Randomized.

Plot Size.—Gross: 10×10=100 plants. Net: 8×8=64 plants.

Trial 10:

Locality.—Benaventura Estate, Yercaud.

Year of Start.—1958 Post-monsoon.

Treatments.—

(A) Bordeaux Mixture.
(B) Flit 406.
(C) Parrycop-50.

Replications.—4.

Lay-out.—Randomized.

Plot Size.—Gross: 20×5 = 100 plants. Net: 18×3 = 54 plants.

Trial 11:

Locality.—C.R.S.S., Chethalli, Coorg.

Year of Start.—1958 Post-monsoon.

Treatments.—

(A) Microcop.

(B) Bordeaux Mixture.
(C) Ultrasulphur.

Replications.—4.

Lay-out.—Randomized.

Plot Size.—Gross: $20 \times 5 = 100$ plants. Net: $18 \times 3 = 45$ plants.

Trial 12:

Locality.—Cheeknahalli Estate, Saklespur.

Year of Start.—1959 Pre-monsoon.

Treatments.—
(A) Flit 406.
(B) Bordeaux Mixture.
(C) Bordeaux Mixture + Tenac Sticker.
(D) Cupricol.

Replications.—4.

Lay-out.—Randomized.

Trial 13:

Locality.—Vasantacool Estate, Chikmagalur.

Year of Start.—1959 Pre-monsoon.

Treatments.—
(A) Parrycop-50.
(B) Bordeaux Mixture.
(C) Cobredon.
(D) Kirticopper.

Replications.—4.

Lay-out.—Randomised.

(*d*) Time of spray trial in North-East Monsoon rainfall areas

This trial started in the Shevaryos during 1957 pre-monsoon period to find out a suitable time schedule for protective spraying against leaf disease was continued. The spray applications as per schedule were imposed. Observations on leaf retention and yield recorded in the different treatments are furnished in Appendix LXII.

Of the three observations on leaf retention recorded so far after start of the trial, treatment A (three sprays an year) is significantly superior over treatments B, C, D and E during February 1959 and during September and February 1958 is *on par* with treatments C, B and D (2 sprays and 1 spray) but superior to treatment E (unsprayed control). Regarding yield of ripe cherry, all sprayed treatments are significantly superior to unsprayed control, but are *on par* between themselves.

(*e*) Spraying of leaf disease resistant selections

To find out whether there are any beneficial effects to be derived through spraying Bordeaux mixture on to leaf disease-resistant selections, two trials have been started recently. A bulk observational trial, where only general observations (vigour of plants and yield) are to be recorded, has been started during early June 1959 in a private estate in Balehonnur. Another critical trial laid out on a randomized replicated basis, where yield records, growth measurements and incidence of diseases other than leaf disease are to be recorded, has been started during this pre-monsoon period at C.R.S.S., Chethalli. Results are awaited.

(*f*) Bordeaux spraying on the upper surface of leaves *vs.* spraying under surface

To find out whether spraying the upper surface of leaves only would afford protection from leaf disease comparable to that provided by under-surface spray, a randomized replicated trial was started during May 1959. The initial observations on leaf retention and disease incidence have been recorded. The details are furnished below:—

Locality.—C.R.S., Balehonnur.

Year of Start.—1959 Pre-monsoon.

Treatments.—

(A) Control—no spray.
(B) Bordeaux ½% .. Under-surface spray.
(C) „ ½% .. Upper-surface spray.
(D) „ 1% .. do.
(E) „ 2% .. do.

Replications.—4.

Lay-out.—Randomized.

Plot Size.—Gross: $5 \times 5 = 40$ plants. Net: $3 \times 6 = 18$ plants.

Results are awaited.

(*g*) Low volume spraying of coffee

With the present high costs of spray materials and labour costs, the question of a successful introduction of some type of low volume spraying is becoming increasingly important. Earlier trials with some of the low volume nozzles fitted to high pressure spraying equipment as well as with low pressure equipment were found to be unsuitable to coffee due to various working difficulties associated with the system of coffee cultivation in South India. In economics also there was nothing very much attractive.

Recently another low volume spraying equipment—Micronette sprayer, a power sprayer working on an air-blast principle has been tried for spraying in coffee. From preliminary trials using this unit, it was found that though one acre of medium-

sized coffee could be sprayed with about 25 gals. of spray mixture, many practical working difficulties were found associated with it.

The practicability of the use of this machine for coffee spraying against leaf disease as well as the effectiveness of the spray in the control of the disease are being further studied.

B. Studies on Brown-Eye-Spot Disease of Coffee

1. Causative Organism

Previous records show that *Cercospora coffeicola* is the fungus responsible for Brown-eye-spot disease in coffee in South India. A detailed study of the disease symptoms on coffee in South India indicated the possibility of two fungi likely to be causing this disease. Isolations in artificial culture and a comparative study of their morphological characters support this view. The two fungi have been tentatively identified as *Cercospora coffeicola* and *C. coffea*. Further detailed study of their morphological characters is contemplated.

2. Comparative Efficacy of Different Fungicides in Controlling the Disease

The trial started in June 1958 to find out the comparative efficacy of different fungicides in controlling Brown-eye-spot disease was continued. Observations recorded on the comparative disease incidence in the different treatments are furnished below:—

Symbol	Treatments	Percentage disease incidence					
		July 1958	Aug. 1958	Sept. 1958	Oct. 1958	Nov. 1958	Dec. 1958
A	Dithane M-22 + Triton Sticker	24·0	26·8	18·1	16·6	11·8	8·8
B	Flit-406 + Triton Sticker	26·0	27·2	17·1	16·0	13·0	8·0
C	Bordeaux 1% + Triton Sticker	22·6	24·6	16·2	14·8	11·0	8·0
D	Bordeaux 1% + Tenac Sticker	24·4	25·8	16·6	15·5	11·0	8·4
E	Bordeaux 1% No sticker	29·0	26·0	17·3	17·0	11·4	8·4
F	Spersul	26·6	33·0	24·8	20·2	20·0	18·7
G	Dithane M-22 + Triton Sticker	27·4	30·4	25·3	20·0	14·1	13·8
H	Flit-406 + Triton Sticker	19·6	31·3	26·3	20·7	15·5	13·6
I	Bordeaux 1% + Triton Sticker	21·0	31·3	25·6	18·0	14·0	13·1
J	Bordeaux 1% + Tenac Sticker	25·9	31·5	26·6	18·2	15·0	13·0
K	Bordeaux 1% No sticker	20·0	31·9	26·3	20·7	16·6	13·2
L	Spersul	30·1	36·5	33·8	28·2	24·4	24·0
M	Unsprayed Control	25·1	46·8	48·6	60·0	58·8	47·5

Note.—Treatments A to F—fortnightly applications; G to L—Monthly applications.

All the spray treatments showed considerably less disease incidence than unsprayed control plots. In general, spray applications at fortnightly intervals gave a better disease control than spray at monthly intervals. Bordeaux mixture is seen to have effected the maximum disease control, Flit-406 and Dithane-M-22 being next in order of efficacy. Addition of stickers to Bordeaux mixture has not appreciably increased the efficacy of disease control. Similar trends were observed in previous year's observations also.

It is however observed, that in both years, the difference in comparative efficacy observed between Bordeuax mixture, Dithane M-22 and Flit-406 is very little.

C. Studies on Kondlie Disease

1. Observations on Incidence, Periodicity and Symptoms of the Disease

For the past two years, heavy seedling losses due to a hitherto unknown disease have been noticed in certian coffee zones. A survey of the incidence and periodicity of the malady in different coffee zones revealed that the disease was fairly widespread, its occurrence being observed in Balehonnur, Aldur, Mudigere, Chikmagalur, Saklespur and Coorg areas. Seedling losses due to this malady in general ranged from 10 to 30 per cent. though, in some cases, it was as high as 50 to 75 per cent.

The disease symptoms become apparent during the period August to October on eight to eleven months old seedlings, either in the nursery or shortly after planting out to the field.

Affected seedlings show a constriction of the main stem, invariably at the primary node (occasionally in between the first and second node or even at the second node), the stem above being bulged or flattened with longitudinal furrows. The tip leaves of the affected plants show invariably an yellowsih or more commonly a coppery brown colour. Affected plants often show a tendency to be tall and lanky in growth with long internodes. Seedlings snap off at the constricted point with the slightest disturbance. In cases where the constriction is above the primary node and when soil moisture conditions are favourable, fresh sucker development from the node below the constricted point is observed. These new suckers have been observed to grow normally without exhibiting the disease symptoms. Where the constriction is at or below the primary node, no sucker development takes place, but formation of thick adventitious roots from the stem above the constricted point is noticed usually.

A certain amount of natural recovery of diseased plants is noticed in the case of mild infections where the constriction is shallow. During the course of recovery, callus formation takes place which cover up the stem constriction and such seedlings survive. The recovery is hastened when the seedlings are protected from exposure to hot sun and when soil moisture conditions are maintained at optimum levels.

A close study of the cultural, manurial and protective practices followed in many estates was made to correlate if possible the incidence of this malady to any one or all of the above practices. Though no conclusive proof is yet available, the general trend appears to be that nurseries receiving frequent and liberal doses of Bordeaux mixture sprays very often showed the disease incidence to a high degree, as compared to nurseries where Bordeaux sprays were absent or limited.

A detailed study of this new malady, to find out the causative agency, factors influencing its incidence and intensity as well as a practical control measure is in progress.

2. Results of Examination of Diseased Seedlings

Microscopic examination of affected seedlings have shown, in a large majority of cases, a fungus belonging to the family "Phomaceæ", associated with the malformed tissues, being mostly confined to the superficial bark tissues. This fungus has been brought in artificial culture and has been tentatively identified as *Chætophoma* sp. From some affected specimens, a *Fusarium* sp. and in a few cases a bacterial culture have also been isolated.

3. Determination of Causative Agency

(*a*) *Artificial Infection Trials.*—In order to find out whether the disease symptoms could be artificially reproduced on healthy seedlings, infection trials involving the following micro-organisms were conducted:—

(1) *Chætophoma* sp. (isolated from Kondlie-affected seedlings)

(2) *Fusarium* sp. do. do.

(3) Bacterial culture do. do.

(4) *Rhizoctonia* sp. (isolated from Collar-rot-affected seedlings)

(5) *Rhizoctonia bataticola* (isolated from coffee seedlings).

Aqueous suspension of a natural scraping from Kondlie affected seedlings was also used for inoculation. In these trials the inoculum was applied with and without injury to the first and second nodes, collar region and root portions of healthy seedlings. These trials were conducted at monthly intervals from May to August. Suitable controls were maintained in each set.

Observations recorded till the end of August, show that in none of the lots, the disease symptoms had developed.

(*b*) To find out whether the disease is transmitted through infected soil or plant material, trials involving the following treatments were conducted:—

(1) Planting affected and healthy seedlings side by side in the same pot.

(2) Planting healthy seedlings in soil which held previously affected plants.

It was seen from observations recorded so far, that none of the healthy seedlings developed the disease symptoms.

4. Influence of Application of Fertilizers and Bordeaux Mixture on the Incidence of the Disease

To find out whether there is any possible relationship between incidence of Kondlie disease and application of Bordeaux mixture and fertilizers, the following trials were conducted.

Trial 1:

Treatments.—

(A) Urea (12 lb. N per 1,200 seedlings).

(B) Sterameal (pinch per seedling).

(C) Ammonium sulphate (12 lb. N per 1,200 seedlings).

(D) Cowdung slurry.

(E) Untreated control.

Sub-Treatments.—

(1) 1 per cent. Bordeaux mixture spray at monthly intervals.

(2) No Bordeaux spray.

Treatment Schedule.—At fortnightly intervals.

Plant Material.—S. 288 basket seedlings.

Date of Sowing Seed.—19–1–1959.

Date of Transplanting Seedlings.—18–3–1959.

Date of Start of Treatments.—2–5–1959.

Date of Start of Bordeaux Application.—31–3–1959.

Replications.—3.

Lay-out.—Randomized.

Plot Size.—20 seedlings per treatment; 10 seedlings per sub-treatment.

Observations on the percentage of disease incidence recorded in the different treatments are furnished in the following table:—

	Unsprayed					Sprayed with Bordeaux				
	Urea	Stera-meal	Am_2SO_4	Cow-dung slurry	Con-trol	Urea	Stera-meal	Am_2SO_4	Cow-dung slurry	Con-trol
Total No. of plants	28	30	23	30	27	30	30	29	30	30
No. affected	Nil	Nil	Nil	Nil	Nil	10	17	14	6	12
Percentage disease						33·3	56·6	47·2	20·0	40·0

It is seen from the above table, that in all the different treatments including unfertilized control plots, where Bordeaux mixture spray was given, disease incidence is noticed; whereas in all the treatments, where Bordeaux mixture was not sprayed, no disease incidence is noticed.

Trial 2

Treatments.—

(A) Urea (12 lb. N per 1,200 seedlings).

(B) NPK (12 : 7 : 12).

(C) Sterameal (pinch per seedling).

(D) Lime (pinch per seedling).

(E) Control—no fertilizer.

Sub-Treatments.—

(1) 1% Bordeaux mixture spray at monthly intervals starting from March

(2) „ „ „ April

(3) „ „ „ May

(4) „ „ „ June

(5) „ „ „ July

(6) „ „ „ August

(7) Unsprayed—Control.

Treatment Schedule.—Once a fortnight.

Plant Material.—S. 288—potted seedlings.

Date of Sowing Seed.—20–1–1959.

Date of Transplanting Seedlings.—20–3–1959.

Date of Start of Treatments.—31–3–1959.

Date of First Bordeaux Application.—31–3–1959.

Replications.—3.

Lay-out.—Randomized.

Plot Size.—7 Pots, each containing 10 seedlings per treatment; 1 pot containing 10 seedlings per sub-treatment.

The observations on the percentage of disease incidence recorded in the different treatments and sub-treatments are furnished in the following table:—

Treatments	Percentage disease incidence						
	Bordeaux spray starting from and number of applications						
	March–6	April–5	May–4	June–3	July–2	August–1	Control No spray
Urea	93·3	84·3	60·0	46·6	20·6	Nil	Nil
NPK	93·3	90·0	86·6	73·3	62·1	Nil	Nil
Sterameal	86·2	93·3	93·3	73·3	22·5	Nil	Nil
Lime	72·4	74·1	71·4	73·3	26·6	3·4	Nil
Control	86·6	90·6	83·3	58·6	43·3	Nil	Nil

It is seen from the above data that—

(1) disease incidence to varying degrees is noticed in the different fertilizer treatments, when combined with Bordeaux applications 6 to 1; whereas in fertilizer treatments alone without Bordeaux applications, no disease incidence is seen.

(2) in unfertilized control plots receiving Bordeaux mixture spray, disease incidence is noticed; whereas in the same, where no Bordeaux mixture spray is given, no disease incidence is seen.

Trial 3:

Treatments.—

(A) Urea (12 lb. N per 1,200 seedlings).

(B) Lime (pinch per seedling).

(C) Lime + Borax (pinch per seedling).

(D) Borax (0·05 p.p.m).

(E) Borax + Potash.

(F) Potash (12 lb. K_2O per 1,200 seedlings).

(G) Bordeaux mixture 1 per cent.

(H) Untreated Control.

Sub-Treatments.—

(1) Seedlings raised in germination beds sterilized with 1 per cent. Bordeaux mixture and transplanted to soil sterilized as above.

(2) Seedlings grown in unsterilized soil.

Treatment Schedule.—Fortnightly intervals.

Plant Material.—S. 333.

Date of Sowing Seed.—23–2–1959.

Date of Transplanting Seedlings.—23–4–1959.

Date of Start of Treatments.—8–5–1959.

Replications.—2.

Plot Size.—4 Pots, each containing 7 seedlings per treatment; 2 pots, each containing 7 seedlings per sub-treatment.

Observations on the percentage of disease incidence recorded are summarized below:—

	Seedlings grown in sterilized soil								Seedlings grown in unsterilized soil							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
Total No. of plants	13	14	13	14	14	13	14	14	13	14	13	13	14	14	12	14
Number infected	..	..	..	..	..	..	..	5	..	..	..	..	..	..	5	..
Percentage disease	..	..	..	..	..	..	..	35·7	..	..	..	..	..	..	41·6	..

It is seen from the above that—

(1) in none of the fertilizer treatments inclusive of the unfertilized control, whether grown in sterilized or unsterilized soil, the disease incidence is noticed;

(2) in the plots receiving Bordeaux mixture spray, the disease incidence is seen.

General Indications from the Foregoing Trials, regarding the Influence of Application of the Fertilizers and Bordeaux Mixture on the Disease Incidence

From the observations recorded in the above detailed trials it is seen that:—

(1) application of major and minor elements by themselves does not appear to have any direct correlation to the disease incidence.

(2) frequent application of Bordeaux mixture either alone or in combination with fertilizers, seems to be correlated with a high incidence of Kondlie disease.

5. Control of Kondlie Disease through Use of Different Chemicals

Information collected and observations recorded during a field survey of a large number of nurseries to find out the incidence, intensity and periodicity of this disease, indicated the possibility of a high incidence of the disease associated with frequent applications of Bordeaux mixture. The following trials were conducted to find out whether Bordeaux mixture spray is associated with a high incidence of the disease as well as to find out a suitable chemical control of the malady.

Trial 1:

Treatments.—

(A) Bordeaux mixture—1 per cent.

(B) Flit-406.—0·4 per cent.

(C) Unsprayed Control.

Sub-Treatments.—

(1) Fortnightly spray application.

(2) Monthly spray application.

Replications.—5.

Lay-out.—Randomized.

Plot Size.—20 Seedlings per treatment; 10 seedlings per sub-treatment.

Date of Start of Treatments.—June 1958.

The observations recorded on the percentage disease incidence in the different treatments are furnished in the following table:—

Treatments and sub-treatments	Percentage disease incidence							
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
Bordeaux mixture—								
Monthly ..	Nil	Nil	Nil	22	26	20	16	16
Fortnightly ..	Nil	Nil	Nil	30	40	36	28	28
Flit-406—								
Monthly ..	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Fortnightly ..	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Unsprayed Control ..	Nil	Nil	Nil	10	18	14	6	6

It is seen from the above table that, the disease incidence is noticed in Bordeaux mixture sprayed/unsprayed control plots; whereas there is no incidence observed in the Flit-406 treated plot. It is also seen that the disease incidence is much higher in Bordeaux-sprayed plots than in the unsprayed control.

Trial 2:

Treatments.—

(A) Flit-406—0·4 per cent.

(B) Bordeaux—1 per cent.

(C) Terrachlor 75 w.p.—1 per cent.

(D) Folidol E-605—0·02 per cent.

(E) Unsprayed Control.

(F) Agrimycin-200 p.p.m.

(G) Ceresan—0·1 per cent.

Spray Schedule.—At monthly intervals.

Plant Material.—S. 288—Basket seedlings.

Date of Sowing Seed.—19-1-1959.

Date of Transplanting Seedlings.—14-3-1959.

Date of First Imposition of Treatments.—24-3-1959.

Replications.—3.

Lay-out.—Randomized.

Plot Size.—10 Basket seedlings per treatment.

Observations on the percentage disease incidence in the different treatments are furnished in the following table:—

	Percentage of disease incidence in the different treatments						
	Flit-406	Bordeaux	Terrachlor	Folidol	Agrimycin	Ceresan	Control
Total No. of plants ..	30	29	28	309	30	28	29
Numbero. affected ..	3	27	Nil	10	6	1	3
Percentage disease ..	10·0	96·5	..	33·3	20·0	3·6	10·3

It is seen from the above that, except in Terrachlor-treated plots, in all other treatments inclusive of the control, the disease incidence is noticed. The highest disease incidence is noticed in Bordeaux-treated plots.

Trial 3:

Treatments.—

(A) Flit-406—0·4 per cent.

(B) Bordeaux mixture—1 per cent.

(C) Terrachlor—75 w.p. 1 per cent.

(D) Dithane M-22—0·4 per cent.

(E) Unsprayed-Control.

(F) Agrimycin—200 p.p.m.

Spray Schedule.—At monthly intervals.

Plant Material.—S. 288—Basket seedlings.

Date of Sowing Seed.—19-1-1959.

Date of Transplanting Seedlings.—14-3-1959.

Date of First Imposition of Treatments.—9-5-1959.

Replications.—3.

Lay-out.—Randomized.

Plot Size.—10 Basket seedlings per treatment.

Observations on the percentage disease incidence recorded in the different treatments are furnished in the following table:—

	Percentage of disease incidence in the different treatments					
	Flit-406	Bordeaux	Terrachlor	Dithane M-22	Agrimycin	Control
Total No. of plants ..	30	30	30	27	30	30
Number affected ..	Nil	11	3	1	Nil	Nil
Percentage disease ..	..	36·6	10·0	3·7	3·3	..

It is seen from the above table that, in the case of Flit-406 and unsprayed control treatments, no disease incidence is noticed; whereas in all the other treatments, disease incidence is noticed. Bordeaux mixture-sprayed plots showed the highest incidence.

Trial 4:

Treatments.—

(A) Seedbed sterilized with 0·8 per cent. Formaldehyde prior to sowing of seed, seedlings transplanted to soil sterilized as above.

(B) Seedbed sterilized with Formaldehyde as above, but seedlings transplanted to unsterilized soil.

(C) Seedbed unsterilized prior to sowing of seed, seedlings transplanted to soil sterilized with Formaldehyde.

(D) Seedbed unsterilized prior to seed sowing, seedlings transplanted to unsterilized soil.

Sub-Treatments.—

(1) Flit-406—0·4 per cent. spray at monthly intervals.

(2) No spray is given.

Plant Material.—S. 333—Bed plants.

Date of Sowing Seed.—5–3–1959.

Date of Transplanting Seedlings.—7–5–1959.

Date of First Application of Flit-406.—25–5–1959.

Plot Size.—40 Seedlings per treatment.

The observations on the disease incidence recorded are furnished below:—

	Sub-treatment 1 Flit-406 sprayed		Sub-treatment 2 unsprayed	
	Total No. of plants	Percentage disease	Total No. of plants	Percentage disease
A	39	Nil	40	Nil
B	39	Nil	31	Nil
C	37	Nil	35	Nil
D	37	Nil	35	Nil

No disease incidence is seen in any of the treatments or sub-treatments.

Trial 5:

Treatments.—

(A) Flit-406—0·4 per cent. spray from May onwards.
(B) „ „ „ June onwards.
(C) „ „ „ July onwards.
(D) „ „ „ August onwards.
(E) Unsprayed-Control.

Spray Schedule.—At fornightly intervals.

Plant Material.—Coorgs.

Date of Sowing Seed.—23–2–1959.

Date of Transplanting Seedlings.—8–5–1959.

Date of Start of Spray.—15–5–1959.

Plot Size.—40 Basket seedlings per treatment.

The observations recorded in this trial on the percentage of disease incidence show, that in none of the treatments, the disease has developed so far.

6. Varietal Susceptibility to the Disease

To find out whether different arabica varieties exhibit any varietal susceptibility to this disease, the following trial was undertaken:—

Treatments.—

(A) Coorgs.
(B) Kents.
(C) S. 333.

Sub-Treatments.—

(1) Bordeaux spray 1 per cent.—at monthly intervals.
(2) No spray.

Date of Sowing.—20–2–1959.

Date of Transplanting Seedlings.—23–4–1959.

Date of Start of Spray.—May 1959.

Plot Size.—50 Bed plants for each treatment; 25 bed plants for each sub-treatment.

Replications.—3.

Lay-out.—Randomized.

Observations on the disease incidence recorded are furnished in the following table:—

	Bordeaux Sprayed			Unsprayed		
	S. 333	Kents	Coorgs	S. 333	Kents	Coorgs
Total No. of plants ..	67	72	74	75	74	75
Number affected ..	3	Nil	4	Nil	Nil	Nil
Percentage disease ..	4·4	..	5·4	..	..	..

It is noticed from the above table that, S. 333 and Coorgs varieties show the disease in Bordeaux-sprayed plots. In Kents variety, disease symptoms have not developed clearly so far.

D. Studies on "Target Leaf-Spot" Disease Caused by *Myrothecium advena* Sacc.

(1) *Viability of the Spores.*—Germination tests with spores of the fungus taken from preserved herbarium specimens and artificial culture, conducted at periodical intervals, have shown that the spores have remained viable for over an year. In inoculated soil also, the fungus has been found to remain viable for over an year.

(2) *Artificial Infection Trials.*—Using aqueous spore suspension in sterile water, inoculations were done on healthy leaves of *Coffea arabica*, *C. excelsa*, *C. liberica*, *C. robusta* and *Erithrina lithosperma*. Only *Coffea arabica* took the infection.

(3) *Influence of Humidity on Infections.*—Artificial inoculations using spore suspensions in sterile water were carried out on fresh healthy leaves of arabica coffee, kept under different relative humidity levels ranging from 30 to 100 per cent. It was observed that infections occurred at a minimum relative humidity level of 70 per cent. and that maximum infections occurred at 100 per cent. levels. This finding supports the observations recorded in the field that usually the disease is noticed only when the atmospheric humidity conditions are high.

E. Studies on Bordeaux Toxicity to Coffee Seedlings

Bordeaux mixture is now being used commonly in nurseries for the control of collar rot disease. Applications to the soil as well as to the plant material are being carried out very often at frequent intervals. Recently some reports have come of the young coffee seedlings in germination beds failing to form normal root system. It is suspected that this malformation may be possibly due to Bordeaux toxicity.

To examine this possibility, the following preliminary trial was conducted.

Seeds were sown in germination beds drenched with Bordeaux mixture ($\frac{1}{2}$, 1 and 2 per cent. strengths) three days prior to sowing as well as in untreated beds: Germination occurred in about 38 days. Comparative observations on the seedlings

germinated in beds sterilized with different concentrations of Bordeaux and untreated ones showed, that in the former, certain abnormalities in the growth of the seedlings occurred. As compared to the normal growth of seedlings in the untreated beds, the root system was very poor and stunted in the Bordeaux-treated beds. The tap root growth was arrested, a mere spindle-shaped stub being produced. The number of lateral roots produced were comparatively few and they were short, thick and stiff. The stem at the collar region was swollen. Seedlings grown in beds treated with 2 per cent. Bordeaux mixture exhibited the toxicity symptoms more pronounced than the lower concentrations.

Such seedlings showing the poor development of the tap root and lateral roots, when transplanted to fresh untreated soil, showed recovery.

F. New Records

(1) A new entomogenous fungus causing biological control of green bug of coffee has been recorded. The morphological characters of this fungus have been studied in detail. It has been identified as *Hypocrella olivacea*.

(2) A new leaf-spot-causing disease of arabica coffee has been recorded recently. The fungus has been brought in artificial culture and its morphological characters studied. It has been identified as *Sacropodium* sp.

K. V. GEORGE,
Mycologist.

APPENDIX I

Statement Showing the Staff of the Research Department as on 31-7-1959

Sl. No.	Designation	Distribution of Staff				
		H.Q. Station Balehonnur	Sub-Station Chethalli	Extension Service	Development plan	Total
1	2	3	4	5	6	7
CLASS I						
1	Director of Research ..	1	..	..	..	1
CLASS II						
2	Chemist	1	..	..	..	1
3	Botanist	1	..	..	..	1
4	Entomologist	1	..	..	..	1
5	Mycologist	1	..	..	..	1
6	Agronomist	1 (Vacant)	..	..	..	1
7	Senior Liaison Officers ..	..	..	3	1	4
8	Superintendent	1 (kept in abeyance)	1	..	..	2
9	Assistant Chemist	1 (Vacant)	..	..	..	1
10	Assistant Botanist	1	..	..	..	1
11	Assistant Mycologist ..	1 (kept in abeyance)	..	..	..	1
12	Junior Liaison Officers ..	..	..	12	..	12
13	Secretary to Director of Research	1	..	..	..	1
CLASS III						
14	Head Clerks	3 (1 kept in abeyance)	1	..	..	4
15	Senior Clerks	4	1	..	..	5
16	Junior Clerks	5	1	7	11	24
17	Stenographer	1	..	..	..	1
18	Camp Clerk	1	..	..	..	1
19	Typists	2	..	..	..	2
20	Store-keeper	1	..	..	..	1
21	Research Assistants	7	2	..	4 (3 Vacant)	13
22	Liaison Assistants	..	..	..	16 (15 Vacant)	16
23	Statistical Assistant ..	..	..	..	1 (Vacant)	1
24	Farm Assistant	1	..	..	..	1
25	Junior Scientific Assistant ..	1	..	..	..	1
26	Fieldmen	11	5	34 (2 Vacant)	14 (Vacant)	64
27	Foreman/Mechanic ..	1	..	..	..	1
28	Fitter	1	1	..	..	1
29	Compounder	1	..	..	..	1
CLASS IV						
30	Drivers	2	1	3	1	7
31	T. B. Attenders	2	1	..	..	3
32	Mechanical Attenders ..	1	1	..	..	2
33	Laboratory Attenders ..	6	1	..	..	7
34	Peons including gestetner operator (one post)	6	1	15 (2 Vacant)	1	23
SCHEME FOR TESTING OF PROPRIETARY PRODUCTS (TEMPORARY FOR 3 YEARS)						
35	Class II Special Officer ..	1	..	..	..	1
36	Class III Assistants ..	3 (1 Vacant)	..	..	..	3
	TOTAL ..	72	17	74	49	211

Appendix II

Statement Showing the Supply of Seed Coffee of Station Selections from 1948–49 to 1958–59

Year	Arabica Station Selections Lb.	Kents Arabica Lb.	Robusta S. 274 Lb.	Robusta Lb.	Excelsa Liberica Lb.	Total Lb.	Number of planters to whom seed was distributed
1948–49	150	262	62	759	2	1,235	164
1949–50	253	173	47	506	..	979	168
1950–51	400	366	40	1,046	1	1,853	237
1951–52	695	80	45	1,139	..	1,959	228
1952–53	888	45	35	875	9	1,852	310
1953–54	1,456	20	106	720	31	2,333	500
1954–55	5,421	..	77	800	39	6,337	1,247
1955–56	10,669	..	189	1,164	27	12,049	1,693
1956–57	13,397	..	45	296	26	13,764	2,034
1957–58	13,504	..	34	780	14	14,332	2,529
1958–59	7,746	..	136	992	32	8,906	2,205
Total ..	54,579	946	816	9,077	181	65,599	11,315

Appendix III

Statement Showing the Distribution of Seed Coffee in Liaison Districts during 1955–56 to 1958–59

Name of the Liaison District	Year 1955–56		Year 1956–57		Year 1957–58		Year 1958–59	
	Arabica	Robusta	Arabica	Robusta	Arabica	Robusta	Arabica	Robusta and Excelsa
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
1. Chikmagalur	2,012	54	1,721	26	1,043	9	772	3
2. Mudigere	2,128	130	3,143	74	3,355	65	1,068	40
Koppa	..	..	..	..	..	..	821	64
3. Saklespur	1,886	152	1,623	30	1,406	12	879	33
4. North Coorg	1,467	30	2,346	3	1,350	12	908	22
5. South Coorg	1,577	76	1,650	2	3,120	102	789	145
6. Yercaud	233	1	428	..	304	2	206	..
7. Kalpetta	755	547	1,439	82	722	220	329	330
8. Coimbatore Anamallais	379	302	462	128	1,906	176	328	56
Pulneys	..	..	..	..	..	..	944	12
Nilgiris	..	..	..	..	..	..	433	..
Kottayam	..	..	..	..	..	..	198	455
9. Other areas	232	88	585	22	298	230	71	..
Total ..	10,669	1,380	13,397	367	13,504	828	7,746	1,160

Appendix IV

Statement Showing the Number of Demonstration Blocks (Improvement Blocks)/ Reorientation Plots/Differential Manurial Blocks/Field Manurial Trial Plots/Verietal Trial Plots and Plant Protection Trial Plots in the Different Liaison Zones

Sl. No.	Name of the Liaison Zone	1957–58 (No. of plots under various trials)					
		Demonstration blocks	Reorientation plots	Differential manurial trial plots	Field manurial trial plots	Varietal trial plots	Plant protection trial plots
1	2	3	4	5	6	7	8
1	Chikmagalur	18	2	4	2	6	4
2	Mudigere	15	11	4	4	6	7
3	Saklespur	21	1	4	8	5	5
4	North Coorg	9	4	..	1	4	4
5	South Coorg	19	2	..	2	..	3
6	Kalpetta	28	..	..	6	4	1
7	Yercaud	20	5	6	1	1	6
8	Coimbatore, Anamallais, Nelliampathies, Nilgiris ..	14	8	4	1	1	2
9	Pulneys	14	6	4	..	4	..
10	Koppa	..	6	..	..	..	..
	Total ..	158	45	26	25	31	32
	Grand Total ..						317

Appendix IV (*Contd.*)

Sl. No.	Name of the Liaison Zone	1958–59 (No. of plots under various trials)						
		Demonstration blocks	Reorientation plots	Differential manurial trial plots	Field manurial trial plots	Varietal trial plots	Plant protection trial plots	Remarks
		9	10	11	12	13	14	15
1	Chikmagalur ..	18	8	4	2	6	4	
2	Mudigere ..	17	11	4	3	6	7	
3	Saklespur ..	18	4	4	8	5	5	
4	North Coorg ..	13	6	..	1	4	4	
5	South Coorg ..	19	9	..	2	..	3	
6	Kalpetta ..	30	5	..	6	4	1	
7	Yercaud ..	16	9	6	1	1	6	
8	Coimbatore, Anamallais, Nelliampathies, Nilgiris	12	..	4	1	1	2	
9	Pulneys	13	6	4	..	4	..	
10	Koppa	..	6	..	1	..	..	
	Total ..	156	64	26	25	31	32	
	Grand Total ..						334	

APPENDIX V

Meteorological Data of the Coffee Research Station, Balehonnur, 1958–59

Sl. No.	Description		Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
1	Highest Maximum Temperature	F	82·0	80·2	83·1	82·5	83·1	86·1	90·8	94·0	93·5	96·0	83·0	77·0
		C.	26·8	26·8	28·4	28·1	28·4	30·1	32·7	34·4	39·2	35·6	28·3	25·0
2	Lowest Maximum Temperature	F.	68·4	72·2	73·5	71·1	76·5	80·0	81·5	88·2	85·5	79·5	71·1	67.5
		C.	20·2	22·3	23·1	21·7	24·7	26·7	27·5	31·2	29·7	26·4	21·7	19·7
3	Highest Minimum Temperature	F.	68·9	66·6	67·4	66·4	64·2	63·2	65·5	68·6	70·0	72·5	69·0	67·5
		C.	20·5	19·2	19·7	19·1	17·9	17·3	18·6	20·3	21·7	22·5	20·6	19·7
4	Lowest Minimum Temperature	F.	64·6	61·0	60·5	58·5	56·4	55·4	58·5	61·0	64·5	63·7	63·2	63·0
		C.	18·1	16·1	15·8	14·7	13·6	13·0	14·7	16·1	18·1	17·6	17·3	17·2
5	Average Maximum Temperature	F.	74·0	75·5	79·1	79·3	79·5	83·3	86·3	90·3	89·5	87·0	78·2	71·5
		C.	23·2	24·2	26·2	26·3	26·4	28·5	30·2	32·4	31·9	30·6	25·7	21·9
6	Average Minimum Temperature	F.	66·2	65·0	63·0	62·1	60·3	59·7	61·5	64·4	67·8	68·0	66·2	65·3
		C.	19·0	18·3	17·3	16·7	15·7	15·4	16·4	18·0	19·9	20·0	19·0	18·5
7	Highest Humidity	%	97	97	97	97	97	97	97	97	97	97	97	97
8	Lowest Humidity	%	93	85	77	73	62	84	71	35	68	83	80	92
9	Average Humidity	%	95	92	88	90	85	93	88	82	89	91	94	95
10	Highest No. of hours of bright sunshine	..	5–30	9–00	10–30	10–00	9–30	10–30	10–30	10–42	11·00	11–30	10–30	5–30
11	Lowest No. of hours of bright sunshine	..	..	..	..	..	7–12	7–30	7–30	7–30	1–12	1–24	0–48	0–00
12	Average No. of hours of bright sunshine	..	1–03	4–22	5–40	6–39	9–11	9–13	10–11	9–45	8–09	7–27	3·00	1–08

13	No. of days on which rainfall was below 10 cents	4	5	3	4	..	..	..	..	1	3	2	1
14	No. of days on which rainfall was between 10–50 cents	8	11	4	1	..	..	..	..	4	10	9	5
15	No. of days on which rainfall was between 50–100 cents	8	3	2	1	..	..	..	..	2	3	3	3
16	No. of days on which rainfall was between 1–2″	11	2	..	..	..	..	..	..	..	..	7	10
17	No. of days on which rainfall was above 2″ ..	..	..	..	..	..	..	..	..	..	..	3	12
18	Total No. of rainy days during the month ..	27	15	7	2	..	..	..	..	6	16	22	30
19	Total rainfall during the month—Inches ..	23·44	6·61	5·42	1·22	..	..	..	..	2·46	4·96	25·57	67·65
	Millimetres ..	595·3	168·0	137·5	30·9	..	..	..	..	62·5	126·0	649·4	1718·2
20	Highest rainfall during the month—Inches ..	1·97	1·24	2·60	0·84	..	..	..	..	0·99	0·94	5·83	8·36
	Millimetres ..	50·0	31·5	66·0	21·3	..	..	..	..	25·1	23·9	148·1	212·3

Appendix VI

Rainfall Data of the Coffee Research Station, Balehonnur, 1958–59

(Rainfall recorded in Inches and Millimetres)

Sl. No.	Month		1948–49	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	Average of 10 years	1958–59
1	August	Inches ..	39·49	25·52	20·11	19·40	28·28	30·70	27·90	15·32	19·96	23·14	24·98	23·44
		Millimetres ..	1002·8	648·2	510·8	492·8	718·3	779·8	708·7	389·1	507·0	587·7	634·5	595·3
2	Septemoer	Inches ..	6·43	14·80	21·12	9·77	3·72	6·07	7·69	13·76	6·26	2·44	9·21	6·61
		Millimetres ..	163·3	375·9	536·5	248·2	94·5	154·2	195·3	349·5	159·0	61·9	233·8	168·0
3	October	Inches ..	6·80	7·99	6·43	6·74	13·07	20·22	6·41	8·37	12·46	17·30	10·58	5·42
		Millimetres ..	172·7	202·9	163·3	171·2	332·0	513·6	162·8	212·6	316·5	439·5	268·7	137·5
4	November	Inches ..	8·59	1·43	1·27	3·12	..	..	..	0·60	4·13	7·27	2·64	1·22
		Millimetres ..	218·2	36·3	32·3	79·3	..	..	..	15·2	104·9	184·6	67·1	30·9
5	December	Inches ..	0·08	..	..	..	1·42	..	0·77	..	..	0·05	0·23	..
		Millimetres ..	2·0	..	..	..	36·1	..	19·6	..	..	1·3	5·9	..
6	January	Inches ..	..	0·02	..	0·14	..	..	..	..	..	0·04	0·02	..
		Millimetres ..	..	0·5	..	3·6	..	..	..	..	..	1·0	0·5	..
7	February	Inches ..	..	0·74	..	1·50	..	..	0·28	0·46	..	..	0·30	..
		Millimetres ..	..	18·8	..	38·1	..	..	7·1	11·7	..	..	7·6	..
8	March	Inches ..	0·44	..	0·53	..	..	2·29	1·80	1·12	0·06	1·18	0·74	..
		Millimetres ..	11·2	..	13·5	..	..	58·2	45·7	28·5	1·5	29·8	18·8	..
9	April	Inches ..	2·16	0·79	3·84	6·29	2·40	9·18	3·54	6·19	3·34	8·01	4·57	2·46
		Millimetres ..	54·9	20·1	97·5	159·8	61·0	233·2	89·9	157·2	84·8	203·8	116·2	62·5
10	May	Inches ..	6·61	3·77	8·43	2·55	0·49	4·40	19·18	3·33	6·69	5·21	6·07	4·96
		Millimetres ..	167·9	95·8	214·1	64·8	12·5	111·8	487·2	84·6	169·9	132·3	154·1	126·0
11	June	Inches ..	10·50	11·57	17·38	13·53	15·36	18·56	20·16	28·30	14·95	20·35	17·07	25·57
		Millimetres ..	266·7	293·9	441·5	343·7	390·1	471·4	512·1	718·8	379·7	517·1	433·5	649·4
12	July	Inches ..	24·60	58·25	29·31	27·72	54·99	43·09	9·52	37·61	37·25	50·49	37·28	67·65
		Millimetres ..	624·8	1479·5	744·5	704·1	1396·1	1094·15	241·8	955·3	946·1	1282·4	946·9	1718·2
	Total ..	Inches ..	105·70	124·88	108·42	90·76	119·73	134·51	97·25	115·06	105·10	135·48	113·69	137·33
		Millimetres ..	2684·8	3171·9	2753·9	2305·3	3041·1	3416·5	2470·1	2922·5	2669·5	3441·4	2887·7	3487·8

APPENDIX VII

Meteorological Data Observed at Coffee Research Sub-Station, Chethalli, during 1958–59

Sl. No.	Meteorological observations	Aug. 1958	Sept. 1958	Oct. 1958	Nov. 1958	Dec. 1958	Jan. 1959	Feb. 1959	March 1959	April 1959	May 1959	June 1959	July 1959
1	Highest Maximum Temperature ..	24·4	24·4	26·7	26·1	26·1	26·1	30·6	32·8	31·1	31·7	26·7	23·9
2	Lowest Maximum Temperature ..	21·1	21·7	22·2	21·7	23·3	23·9	25·0	28·3	26·1	25·6	21·0	21·1
3	Highest Minimum Temperature ..	22·2	22·2	22·2	22·2	21·1	21·1	23·3	25·6	24·4	25·0	23·9	20·6
4	Lowest Minimum Temperature ..	19·4	20·6	20·0	18·9	17·8	18·9	20·0	21·1	21·1	22·8	19·4	18·9
5	Average Maximum Temperature ..	22·8	23·4	24·6	24·6	24·2	23·6	27·1	30·1	28·9	24·9	24·3	22·2
6	Average Minimum Temperature ..	20·8	21·0	21·0	21·0	20·0	20·8	21·3	23·0	23·4	23·7	22·1	20·1
7	No. of days on which rainfall was below 10 cents ..	2	8	2	1	..	..	..	1	3	4	2	..
8	No. of days on which rainfall was between 10–50 cents ..	16	6	7	3	..	..	..	..	4	4	3	6
9	No. of days on which rainfall was between 50 to 100 cents ..	7	1	2	1	..	..	..	..	..	3	4	7
10	No. of days on which rainfall was between 1–2″ ..	2	..	..	1	..	..	..	..	..	1	7	8
11	No. of days on which rainfall was above 2″ ..	..	..	..	..	..	..	..	..	..	..	2	8
12	No. of rainy days during the month ..	27	15	11	6	..	..	..	1	7	12	18	29
13	Highest rainfall during the month ..	33·40 (1·32″)	19·30 (0·76″)	24·15 (0·95″)	26·90 (1·06″)	..	..	..	0·50 (0·02″)	8·50 (0·34″)	25·40 (1·00″)	160·90 (6·34″)	140·10 (4·10″)
14	Total rainfall during the month ..	315·45 (12·47″)	76·66 (3·04″)	87·55 (3·77″)	65·65 (2·59″)	..	..	..	0·50 (0·02″)	30·50 (1·22″)	109·40 (4·34″)	559·30 (22·06″)	988·50 (39·26″)

APPENDIX VIII

Rainfall Record of Coffee Research Sub-Station, Chethalli, 1958–59

Sl. No.	Months	1948–49	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	Average for 10 years	1958–59
1	August mm. ..	546·3	219·2	233·7	160·8	269·2	389·9	308·1	147·8	255·0	283·7	281·4	316·7
2	September ..	91·2	149·1	351·8	242·3	57·9	45·0	103·6	144·5	63·0	9·4	125·7	77·2
3	October ..	92·5	224·8	82·5	162·1	209·5	353·3	195·1	273·1	281·9	243·8	211·8	95·8
4	November ..	132·6	2·5	102·9	85·9	..	..	..	19·1	130·8	105·4	57·9	65·8
5	December ..	2·3	..	..	..	53·6	..	35·3	..	..	..	9·1	..
6	January ..	0·8	..	..	..	..	..	..	12·7	..	1·3	1·5	..
7	February ..	..	18·0	..	2·3	..	14·7	..	0·8	..	..	3·6	..
8	March ..	0·5	..	55·1	..	4·6	31·0	11·7	4·6	3·8	15·2	12·7	0·5
9	April ..	96·0	30·0	60·2	111·0	54·4	117·3	142·5	125·0	62·2	63·5	86·6	31·0
10	May.. ..	279·9	94·2	106·4	78·5	26·2	152·1	296·9	74·4	209·3	221·5	153·9	110·2
11	June ..	174·0	173·5	227·3	202·3	309·1	297·4	331·2	474·2	310·9	261·4	277·1	560·3
12	July ..	389·9	726·4	529·8	301·2	827·8	651·8	133·3	552·5	565·7	719·6	539·7	997·2
	TOTAL cm. ..	180·5	163·8	175·5	135·6	181·2	205·3	155·8	182·9	188·2	192·5	175·9	225·5

Appendix IX

Soil Cultivation Experiment

Locality : Coffee Research Station, Balehonnur.

Design : Randomized Blocks.

Treatments : 6.

Plot Size : 4×20 = 80 plants (4·5 cents).

Total area under Experiment : 1·08 acres.

Year of Commencement : 1954–55.

Replications : 4.

Variety : Coorgs Arabica.

Age : 30 years.

Spacing : 5′×5′ or 1·52 metres×1·52 metres.

Sl. No.	Treatments	Yield of ripe cherry in lb. per acre						Yield of clean coffee in cwt. per acre					
		1954–55	1955–56	1956–57	1957–58	1958–59	Average for 4 years	1954–55	1955–56	1956–57	1957–58	1958–59	Average for 4 years
A.	Trenching $1\frac{1}{2}' \times \frac{3}{4}' \times 5'$ ..	3204	4779	2097	4058	3785	3679	5·27	7·22	3·34	6·23	5·63	5·60
B.	Trenching $\frac{3}{4}' \times \frac{3}{4}' \times 5'$ ..	4092	3030	2609	5195	5008	3961	6·85	4·40	4·10	7·97	7·45	5·98
C.	Renovation pitting $1\frac{1}{2}' \times \frac{3}{4}' \times 3'$	3673	3382	3475	3719	4642	3805	5·95	5·28	5·65	5·53	6·91	5·84
D.	Deep digging—November	3872	3273	2909	4270	4102	3639	6·05	5·25	4·45	6·55	6·10	5·59
E.	Light digging—November	3855	2798	2739	3618	4990	3536	6·56	4·29	4·30	5·55	7·43	5·39
F.	Control (Weeding only) ..	3873	3147	3046	3477	3938	3402	6·38	4·83	4·78	5·17	5·86	5·16
	General Mean	3762	3397	2811	4056	4411	3669	6·18	5·20	4·43	6·17	6·56	5·59
	S.E.M.	588·7	477·4	354·3	445·4	485·0							
	Significance	Basic	No	No	No	No							

APPENDIX X

Soil Management Experiment

Locality : Coffee Research Station, Balehonnur.

Design : Randomized Blocks.

Treatments : 7.

Plot Size : 5×16 = 80 plants (4·5 cents).

Age : 30 years.

Year of Commencement : 1954–55.

Replications : 4.

Variety : Coorgs Arabica.

Area under Experiment : 1·2 acres.

Spacing : 5′×5′ (1·52 metres×1·52 metres).

Treatments	Yield of ripe cherry in lb. per acre						Yield of clean coffee in cwt. per acre					
	1954–55	1955–56	1956–57	1957–58	1958–59	Average for 4 years	1954–55	1955–56	1956–57	1957–58	1958–59	Average for 4 years
A. Deep Digging—August ..	6698	5790	1972	4003	4276	4010	10·65	8·89	3·05	6·33	6·36	6·16
B. Light Digging—August ..	6175	7054	2393	4004	4057	4377	10·34	10·04	3·59	6·33	6·04	6·50
C. Deep digging—November	4949	6373	1757	4752	4362	4311	8·01	9·78	2·74	7·18	6·49	6·55
D. Light digging—November	5842	7232	2192	4026	4336	4447	9·78	10·99	3·36	6·08	6·45	6·72
E. Deep digging—April ..	5543	6368	1743	4329	4362	4201	9·12	9·06	2·71	6·54	6·49	6·20
F. Scuffling—April	4451	5573	1644	4616	3521	3839	6·96	8·71	2·48	7·40	5·24	5·96
G. Control (Weeding only) ..	6151	5184	2560	3830	4349	3981	9·96	7·60	4·08	5·98	6·47	6·03
General Mean	5687	6225	2037	4222	4180	4166	9·26	9·29	3·14	6·55	6·22	6·30
S.E.M.	540·7	740·8	237·6	593·0	381·4							
Significance	Basic	No	No	No	No							

Appendix XI

Manurial Experiment on Robusta

Locality : Coffee Research Station, Balehonnur.

Design : Randomized Blocks.

Treatments : 3.

Total Area under Experiment : 0·85 acres.

Year of Commencement : 1951–52.

Replications : 6.

Plot Size : Gross: 4×8 = 32 plants.

Net: 2×6 = 12 plants.

Treatments	Yield of ripe cherry in lb. per acre								Yield of clean coffee in cwt. per acre							
	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59
A. Manured at NPK 40: 30: 40	1793	2427	3231	2494	4099	2724	4118	3220	3·02	4·78	6·01	4·01	7·78	5·11	7·85	5·75
B. Manured at NPK 80: 30: 40	1804	2175	2710	2338	4932	2452	5705	3465	3·27	4·35	4·64	3·76	9·26	4·60	10·88	6·19
C. Control— No manure	1331	2333	3231	2254	4826	2145	4864	2719	2·44	4·60	5·41	3·62	9·06	3·83	9·00	4·82
General Mean	1625	2311	3057	2362	4619	2440	4896	3135	2·91	4·58	5·35	3·80	8·70	4·51	9·24	5·59
S.E.M.		231·8	392·1	259·0	386·6	261·2	505·0	387·7								
Significance	Basic	No	No	No	No	No	No	No								

Appendix XII

Robusta Manurial and Pruning Experiment

Locality : Badra Estate, Balehonnur.

Year of Commencement : 1952–53.

Design : Latin square.

Replications : 6.

Treatments : 6.

Total Area under Experiment : 3·17 acres.

Plot Size : Gross: 6×10 = 60 plants (8·8 cents);

Net Plot: 4×8 = 32 plants (4·7 cents).

Treatments	Yield of ripe cherry in lb. per acre							Yield of clean coffee in cwt. per acre						
	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59
A. Control (no manure) ..	3836	3417	4178	3340	5465	3411	5784	6·80	5·49	7·09	5·67	10·25	6·24	10·33
B. Pruned (no manure) ..	3586	3346	3889	3657	5507	3747	5907	6·31	5·67	7·31	5·88	10·33	6·85	10·59
C. Manured at N P K 40–30–40 ..	3707	3705	3687	4739	5100	3262	6204	6·48	5·96	6·91	8·89	9·56	6·02	11·08
D. ,, 80–30–40 ..	4038	3623	4133	4232	5236	3616	6655	7·10	5·39	7·75	7·56	9·82	6·78	11·88
E. ,, 40–30–40 + Pruned	4265	3664	5046	4623	5178	3574	6937	7·49	5·89	10·36	9·08	10·17	6·71	12·39
F. ,, 80:30:40 + Pruned	3925	3665	4164	4677	4928	3609	7773	6·79	6·68	7·81	8·77	9·68	7·05	13·88
General Mean	3893	3570	4183	4212	5235	3537	6543	6·81	5·88	7·87	7·64	9·97	6·61	11·68
S.E.M.	693·7	432·2	421·5	425·8	429·1	300·9	634·5							
Significance	Basic	No	No	No	No	No	No							

APPENDIX XIII

Robusta Manurial and Pruning Experiment

Locality : Devadhanam Estate, Balehonnur.

Year of Commencement : 1952–53.

Design : Latin square.

Replications : 6.

Treatments : 6.

Total Area under the Experiment : 3·17 acres.

Plot Size : Gross: 6×10 = 60 plants (8·8 cents);

Net Plot: 4×8 = 32 plants (4·7 cents).

Treatments	Yield of ripe cherry in lb. per acre							Yield of clean coffee in cwt. per acre						
	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59
A. Control (no manure) ..	5428	3097	3682	2975	6697	2632	8324	9·27	4·98	6·25	4·78	12·56	4·53	14·86
B. Pruned (no manure) ..	5983	2812	4393	2604	5387	2501	8507	8·93	4·52	8·24	4·18	10·10	4·46	15·19
C. Manured at N P K 40–30–40 ..	5817	3472	3781	2546	6472	2756	9426	8·50	5·58	7·09	4·77	12·13	4·61	16·84
D. ,, 80–30–40 ..	5688	3466	4543	2894	5872	3081	9716	9·82	5·03	8·92	5·17	11·01	5·35	17·35
E. ,, 40–30–40 + Pruned ..	6545	3167	4156	3221	7419	3294	8878	11·52	5·09	8·53	6·33	14·51	6·23	15·85
F. ,, 80–30–40 + Pruned ..	6040	3371	4699	3078	7294	3244	10844	10·79	6·27	8·81	5·77	14·26	5·93	19·36
S.E.M.	417·2	333·3	390·3	346·8	514·8	262·2	523·5							
General Mean	5917	3231	4209	2886	6524	2918	9283	10·31	5·25	7·97	5·17	12·43	5·19	16·58
Significance	Basic	No	No	No	No	No	Yes*							
C.D.=1545					FDCEBA									

Appendix XIV

Experiment on the Influence of Topping on Growth and Yield of Robusta

Locality : Byregudde Estate.
Year of Commencement : 1951–52.
Design : A B B A Pattern.
Plot Size : 4×8 = 32 plants (5·95 cents).
Treatments : 2.
Total Area under Experiment : 1·43 acres.
Replications : 12.
Spacing : 9′×9′ (2·74 metres×2·74 metres).

Treatments	Mean stem girth measurements in cm.			Yield of ripe cherry in lb. per acre			
	1955–56	1956–57	1957–58	1955–56	1956–57	1957–58	1958–59
A. Topped at 3 feet height	5·75	6·58	6·95	469	532	1285	2101
B. Topped at 4 feet height	5·64	6·41	6·77	668	654	1337	2402
General Mean	5·69	6·50	6·86	568	593	1311	2251
S.E.M.			0·25	77·7	46·6	271·8	
Significance			No	No	No	No	

Appendix XV

Mulching Experiment

Locality : Coffee Research Station, Balehonnur. *Year of Commencement :* 1956–57.
Design : Randomized Blocks. *Variety :* Arabica Selection.
Treatments : 6. *Total Area under Experiment :* 0·68 acre.
Replications : 4. *Plot Size :* Gross: 35 plants (2·89 cents).
Net: 15 plants (1·24 cents).

	Treatments	Mean stem girth measurement in cm.				Yield of ripe cherry in lb. (acre)	
		1957	1958	1959	Increase over previous year	1957–58	1958–59
A	Control (no mulch)	1·5	2·1	3·3	1·1	61	828
B	Mulching with dry leaves at 3 tons per acre	1·4	2·0	3·2	1·2	68	667
C	Mulching with cherry husk at 3 tons per acre	1·7	2·4	3·5	1·1	95	1461
D	Cover cropping	1·5	2·2	3·0	0·9	174	1195
E	Green Manure before Monsoon ..	1·3	2·1	3·0	0·9	118	907
F	Green Manure after Monsoon ..	1·3	2·0	2·8	0·8	47	682
	General Mean	1·4	2·1	3·1	1·0	94	957
	S.E.M.	0·34	0·49	0·67	0·43	29·8	302·8
	Significance	Basic	No	No	No	Basic	No

Appendix XVI

Mulching-cum-*Manurial Experiment*

Locality : Coffee Research Station, Balehonnur. *Year of Commencement :* 1956–57.
Design : Randomized Blocks. *Variety :* Arabica Selection.
Treatments : 6. *Total Area under Experiment :* 0·68 acres.
Replications : 4. *Plot Size :* Gross: 35 plants (2·89 cents).
Net: 15 plants (1·24 cents).

	Treatments	Mean Stem Girth Measurement in cm.				Yield of ripe cherry in lb./acre	
		1957	1958	1959	Increase over previous year	1957–58	1958–59
A	Manured NPK at 20 : 30 : 40 ..	1·4	2·3	3·3	1·0	393	2193
B	Manured NPK at 40 : 30 : 40 ..	1·2	2·1	3·3	1·2	197	1886
C	Manured as in A + Dry leaf mulch at 3 tons per acre	1·4	2·5	3·5	1·2	690	4047
D	Manured as in B + Dry leaf mulch at 3 tons per acre	1·3	2·4	3·4	1·0	742	2361
E	Manured as in A + Cherry husk mulch at 3 tons per acre ..	1·5	2·4	3·4	1·1	371	3071
F	Manured as in B + Cherry husk mulch at 3 tons per acre ..	1·4	2·4	3·5	1·2	358	2117
	General Mean	1·3	2·4	3·4	1·1	458	2613
	S.E.M.	0·34	0·48	0·58	0·10	245·7	816·5
	Significance	Basic	No	No	No	Basic	No

Appendix XVII

Crop Estimation Studies—1958–59 (*Kenyan Pre-Harvest Stripping Method*)

Sl. No.	Liaison Zone	Estates Selected	Estimates and actuals for the selected areas for crop estimation studies					Percentage of difference close to the actuals either in I or II stripping
			Blossom in tons	I Stripping in tons	II Stripping in tons	III Stripping in tons	Actual crop picked in tons	
1	Shevaroys	(i) Arcadia	7	6·1	13·6	..	16·66	24·3 (II)
		(ii) Cainton	4	1·0	1·5	..	1·43	4·6 (II)
2	North Coorg ..	(i) Kibbetta	3·75–4	3·4	2·3	..	3·75	9·3 (I)
		(ii) Masgode	8–9	8·6	6·3	..	9·50	9·4 (I)
		(iii) Madegode	5	2·6	4·4	..	5·25	16·0 (II)
3	Saklespur	(i) Goorghully	45	36·8	54·0	..	34·00	7·6 (I)
		(ii) Kendanamane	10	7·1	8·7	..	5·50	22·5 (I)
		(iii) Sulugode	35	32·2	28·7	..	31·00	3·7 (I)
		(iv) Biccode	22	44·4	34·2	..	20·00	9·0 (B)
		(v) Doddalakkunda	50	36·0	52·6	..	47·00	6·0 (B)
4	Chikmagalur ..	(i) Vasantcool	31	16·7	16·0	..	18·00	7·2 (I)
		(ii) Chandragiri	37	23·4	40·7	..	19·75	15·6 (I)
		(iii) Shivagiri	5	3·7	1·7	..	1·75	2·8 (II)
		(iv) Gowrishanker	8·5	5·9	5·5	..	4·75	13·6 (II)

Sl. No.	Liaison Zone	Estates Selected	Estimates and actuals for the selected areas for crop estimation studies					Percentage o difference close to the actuals either in I or II stripping
			Blossom in tons	I Stripping in tons	II Stripping in tons	III Stripping in tons	Actual crop picked in tons	
5	Mudigere ..	(i) Hegguddlu	15·0	70·6	66·9	..	19·20	21·8 (B)
		(ii) Javali	14·0	8·5	6·6	..	11·55	17·5 (B)
6	South Coorg ..	(i) Athitope	3·5	3·1	3·7	..	7·50	50·6 (II)
		(ii) Hovinakadu	39·5	62·7	65·9	..	132·50	50·3 (II)
		(iii) Balmany	15·0	13·8	14·0	..	24·67	43·3 (II)
		(iv) Alitopoo	10·4	10·3	10·7	..	30·00	64·3 (II)
		(v) Ramakrishna	1·5	4·5 (cwt.)	6·1 (cwt.)	..	10·0 (cwt.)	39·0 (II)
		(vi) Kondamuri	55·0	41·4	54·9	..	23·90	42·2 (I)
		(vii) Yemmegundi	51·9	50·1	49·9	..	125·00	59·8 (I)
7	Pulneys	(i) Kanalkadoo	25·0	52·4	..	..	15·00	40·0 (B)
		(ii) Periamalai	1·5	1·2	..	..	1·25	0·8 (I)
		(iii) Nighalkapi	2·8	1·0	..	..	1·33	21·0 (I)
		(iv) Rothaikadoo	1·0	11·2 (cwt.)	..	..	10·00 (cwt.)	10·7 (I)
		(v) Periamalai	5·0	17·2 (cwt.)	..	..	3·13	37·0 (B)
8	Nilgiris ..	(i) Athigundu	9·0	4·6	4·6	..	7·00	22·2 (B)
		(ii) Benhope	3·5	2·3	3·4	..	3·50	2·8 (II)
		(iii) Mailoor	5·5	4·6	7·8	..	5·50	16·3 (I)
		(iv) Glenburn	20·0	16·6	8·9	..	15·25	8·1 (I)
9	Kalpetta	(i) Porkady	4·0	7·3	10·4	..	8·70	16·0 (II)
		(ii) Vijaya Padripara	15·0	25·9	27·0	..	24·70	4·6 (I)
		(iii) Puliyarmala	15·0	29·4	17·4	..	23·4	20·4 (I)
		(iv) North Carolina	17·5	17·9	18·0	..	28·9	37·7 (II)
		(v) Puthu Thottam	6·5	6·9	13·6	..	12·31	9·4 (II)
Coffee Research Station, Balehonnur			22·0	22·9	20·1	15·69	19·93	0·8 (II)
Coffee Research Sub-Station, Chethalli			28·0	21·6	22·1	30·88	25·00	11·6 (II)

Appendix XVIII

Soil Cultivation Experiment

Locality : Coffee Research Sub-Station, Chethalli.

Year of Commencement : 1953–54.

Design : Latin square.

Variety : Coorgs Arabica.

Treatments : 6.

Total Area under Experiment : 4·80 acres.

Replications : 6.

Plot Size : Gross: 120 plants.
Net: 112 plants.

Treatments	Yield of ripe cherry in lb. per acre					Yield of clean coffee in cwt. per acre				
	1954–55	1955–56	1956–57	1957–58	1958–59	1954–55	1955–56	1956–57	1957–58	1958–59
A. Trenching 1½ feet deep	1733	1710	7001	3350	3370	2·58	2·54	10·42	4·99	5·01
B. Trenching ¾ foot deep	1535	1680	7321	3171	3035	2·29	2·50	10·89	4·72	4·52
C. Renovation pitting	1763	1792	7136	2940	3341	2·62	2·67	10·61	4·38	4·97
D. Light digging	1358	1920	7106	3127	3013	2·02	2·86	10·57	4·65	4·48
E. Deep Digging	1613	1920	7047	3526	2698	2·40	2·86	10·48	5·25	4·54
F. Control (Weeding only)	1920	1837	7847	3117	2894	2·81	2·73	11·67	4·64	4·31
General Mean	1650	1810	7243	3205	3058	2·46	2·69	10·71	4·77	4·64
S.E.M.	8·89	6·81	1031·4	365·8	494·0					
Significance	No	No	No	No	No					

APPENDIX XIX

Shade Experiment

Locality : Coffee Research Sub-Station, Chethalli. *Replications :* 6.

Design : Randomized Blocks. *Variety :* Arabica Selection.

Treatments : 10. *Spacing :* 6½′×6½′ or 1·98 metres×1·98 metres.

Plot Size : 12×12 = 144 plants. *Area under Experiment :* 12·5 acres or 4·86 hectares.

Year of Commencement : 1955–56.

	Treatments	Yield of ripe cherry in lb. per acre 1958–59	Yield of clean coffee in cwt. per acre
A.	*Bischofia javanica* omitted	3049	4·53
B.	*Artocarpus integra* ,, ...	3400	5·06
C.	*Ficus nervosa* ,, ...	3722	5·53
D.	*Ficus retusa* ,, ...	3422	5·09
E.	*Albizzia lebbeck* ,, ...	3429	5·10
F.	*Dalbergia latifolia* ,, ...	3565	5·30
G.	*Eugenia jambolana* ,, ...	3779	5·62
H.	*Pterocarpus marsupium* ,, ...	3071	4·56
I.	*Ficus* sp. (*Elibasari*) ,, ...	3500	5·20
J.	*Ficus glomerata* ,, ...	4116	6·12
	General Mean	3505	5·21
	S.E.M.	323·4	
	Significance	Basic	

Appendix XX

Comparative Trials of Clonal Progeny—B.A. Series I

Locality : Balehonnur, Mysore State.
Lay-out : Randomized block.
Variety : Arabica Hybrids.
Plot : 3 plants in a row.
Replications : 8.
Treatments : 20 cultures of the BA series.
Area of Experimental Block : 59·5 cents.
Spacing : 6′×6′.
Guard rows : One on either side.
Shade : Natural shade.

Mean Yield of Replications: Calculated yield of clean coffee in cwt. per acre (1,200 plants)

Cultures	Yield in cwt. during					Averages of 5 years
	1954–55	1955–56	1956–57	1957–58	1958–59	
B.A. 5	0·60	1·49	0·95	7·34	4·36	2·95
B.A. 6	1·05	1·68	1·07	5·02	6·51	3·07
B.A. 11	2·25	2·84	3·95	11·01	5·29	5·07
B.A. 12	5·22	3·35	2·34	10·92	5·88	5·54
B.A. 13	2·79	1·19	3·65	9·14	7·04	4·76
B.A. 19	5·76	2·21	2·29	8·24	5·81	4·86
B.A. 20	3·15	1·51	3·12	6·57	6·39	4·15
B.A. 21	0·96	1·08	1·59	9·99	5·66	3·86
B.A. 22	2·43	2·39	1·65	7·50	4·54	3·70
B.A. 23	3·45	2·26	3·05	9·73	5·67	4·83
B.A. 24	1·14	0·31	2·48	9·01	3·52	3·29
B.A. 25	1·44	1·11	1·47	10·55	4·32	3·78
B.A. 26	0·75	1·41	1·79	4·41	2·37	2·15
B.A. 27	1·05	1·51	1·18	6·57	3·46	2·75
B.A. 30	0·48	1·26	1·23	6·92	3·47	2·67
B.A. 31	2·85	3·94	0·98	6·42	2·21	3·28
B.A. 32	1·08	1·60	0·49	3·68	2·74	1·92
B.A. 34	1·41	1·68	0·31	2·64	1·93	1·59
B.A. 35	2·61	2·88	3·07	6·82	3·34	3·74
B.A. 36	2·04	2·18	1·67	10·74	5·24	4·37

Appendix XXI

Comparative trials of Clonal Progeny—B.A. Series II

Locality : Balehonnur (Mysore State).

Variety : Arabica Hybrids.

Replications : 6.

Area of Experimental Block : 45 cents.

Spacing : 6′×6′.

Guard Rows : One on either side.

Lay-out : Randomized Block.

Plots : 3 Plants in a Row.

Treatment : 15 Arabica Cultures of B.A. Series and Seedling progeny of 645⅛ (B.A. 19).

Shade : Natural Shade.

Mean Yield of Replications: Calculated yield of Clean Coffee in cwt. per acre (1,200 plants)

Cultures	Yield in cwt. during				Cultures	Yield in cwt. during			
	1956–57	1957–58	1958–59	Average for 3 years		1956–57	1957–58	1958–59	Average for 3 years
B.A. 1 ..	1·90	3·49	5·08	3·49	B.A. 15 ..	0·10	0·85	1·14	0·70
B.A. 4 ..	1·12	3·46	3·90	2·83	B.A. 16 ..	4·49	5·21	2·59	4·10
B.A. 7 ..	0·20	4·13	1·93	2·09	B.A. 17 ..	0·15	2·31	2·35	1·60
B.A. 8 ..	0·22	0·14	1·15	0·50	B.A. 18 ..	5·49	5·30	4·94	5·24
B.A. 9 ..	1·46	4·22	4·54	3·41	B.A. 19 (645⅛) ..	2·75	2·21	6·48	3·81
B.A. 10 ..	1·07	2·91	1·83	1·94	B.A. 28 ..	6·15	5·44	3·13	4·91
B.A. 13 ..	1·90	4·62	3·30	3·27	B.A. 29 ..	0·63	3·39	2·89	2·30
B.A. 14 ..	0·20	2·38	2·89	1·82	B.A. 33 ..	2·78	3·14	5·23	3·72

Appendix XXII

Comparative Trials of Clonal Progeny—B.R. Series I

Locality : Balehonnur (Mysore State).
Variety : Robusta.
Treatments : 10 Cultures of the B.R. Series.
Replications : 9.
Spacing : 9′×9′.
Lay-out : Randomized Block.
Plot : 3 plants in a row.
Guard row : One on either side.
Shade : Natural shade.
Area of the Experimental Block : 96 cents.
Mean Yield of Cultures: Calculated yield of clean coffee in cwt. per acre (538 plants)

Cultures	Yield in cwt. during				Average for 4 years
	1955–56	1956–57	1957–58	1958–59	
B.R. 2	0·4	0·81	3·87	3·01	2·02
B.R. 3	1·7	0·98	6·73	3·42	3·21
B.R. 5	1·1	1·04	5·78	5·20	3·28
B.R. 6	2·9	1·89	8·24	5·24	4·57
B.R. 7	1·4	2·28	4·75	4·21	3·16
B.R. 9	1·8	0·43	8·80	3·35	5·60
B.R. 11	1·5	1·10	4·96	1·55	2·28
B.R. 12	4·2	0·93	8·78	2·83	4·19
B.R. 15	0·3	0·82	3·61	4·45	2·30
B.R. 17	1·4	0·81	1·14	4·36	1·93

Appendix XXIII

Comparative Trials of Clonal Progeny—B.R. Series II

Locality : Balehonnur (Mysore State).
Variety : Robusta.
Treatments : 9 Cultures of the B.R. Series and Seedling progeny of S. 274 (Robusta).
Replications : 8.
Spacing : 9′×9′.
Lay-out : Randomized Blocks.
Plot : 3 plants in a row.
Guard row : One on either side.
Shade : Natural shade.
Area of Experimental Block : 93 cents.
Treatments : The cultures of the B.R. Series are:—
B.R. 1, B.R. 4, B.R. 6, B.R. 8, B.R. 10, B.R. 13, B.R. 14, B.R. 16, B.R. 17 and S. 274 seedlings.
Mean Yield of Replications: Calculated yield of clean coffee in cwt. per acre (538 plants)

Cultures	Yield in cwt. during			Average of 3 years
	1956–57	1957–58	1958–59	
B.R. 1	0·44	0·35	0·15	0·31
B.R. 4	0·97	1·59	1·80	1·45
B.R. 6	0·55	2·53	2·00	1·69
B.R. 8	0·66	1·68	2·75	1·70
B.R. 10	1·23	2·53	4·84	2·87
B.R. 13	1·03	1·95	1·38	1·45
B.R. 14	1·99	2·57	5·26	3·27
B.R. 16	0·58	2·19	2·28	1·68
B.R. 17	0·52	1·04	1·62	1·06
S. 274—Robusta Seedlings	0·92	2·07	1·12	1·37

APPENDIX XXIV

Yield Data of Multiple Stem vs. *Single Stem System of Growing Coffee—Experiment I*

Locality : Balehonnur (Mysore State).
Variety : S. 288, S. 333, S. 433, S. 434 and Kents arabica. (Each variety having 12 rows of 16 plants in each row.)
Treatments : A. Single Stem; B. Multiple Stem.
Lay-out : AB, BA Pattern.
Age of Plants : 13 years from seed.
Period of Conversion : May 1950.
Shade : Natural shade.
Spacing : 6′×6′.
Area of Experimental Block : 95·2 cents.

Year	Description of Crop	Yield of ripe cherry (actual) in lb. and calculated yield of clean coffee in cwt./acre (1,200 plants)													
		A. Single Stem							B. Multiple Stem						
		S. 288	S. 333	Kents	S. 433	S. 434	Kents	Mean	S. 288	S. 333	Kents	S. 433	S. 434	Kents	Mean
1952	Ripe Cherry ..	63	83	19	7	22	22	36	21	8	7	4	5	3	8
	Clean Coffee ..	1·17	1·52	0·35	0·13	0·42	0·41	0·66	0·38	0·15	0·13	0·07	0·09	0·06	0·15
1953	Ripe Cherry ..	55	98	32	103	116	10	69	177	83	28	99	135	8	88
	Clean Coffee ..	1·02	1·82	0·60	1·92	2·16	0·18	1·28	3·28	1·53	0·52	1·83	2·52	0·15	1·64
1954	Ripe Cherry ..	243	421	226	227	416	374	318	463	338	370	452	643	160	404
	Clean Coffee ..	4·52	7·83	4·20	4·22	7·74	6·96	5·91	8·6	6·28	6·88	8·41	11·96	2·98	7·52
1955	Ripe Cherry ..	180	128	115	49	62	75	101	144	125	113	73	56	84	99
	Clean Coffee ..	3·34	2·38	2·13	0·91	1·15	1·39	1·88	2·68	2·32	2·12	1·36	1·04	1·56	1·85
1956	Ripe Cherry ..	643	597	404	328	539	248	460	880	622	267	225	367	117	413
	Clean Coffee ..	11·96	11·14	7·51	6·10	10·03	4·61	8·56	16·37	12·46	4·97	4·19	6·82	2·18	7·83
1957	Ripe Cherry ..	206	119	45	74	58	40	90	147	118	53	92	135	70	103
	Clean Coffee ..	3·83	2·21	0·84	1·38	1·08	0·74	1·68	2·73	2·19	0·99	1·41	2·52	1·30	1·86
1958	Ripe Cherry ..	904	982	253	348	653	362	584	445	310	140	196	224	227	257
	Clean Coffee ..	16·81	18·27	4·71	6·47	12·15	6·73	10·86	8·28	5·77	2·60	3·65	4·17	4·22	4·78
1959	Ripe Cherry ..	328	257	126	182	136	89	186	287	233	47	129	168	192	176
	Clean Coffee ..	6·10	4·77	2·34	3·39	2·53	1·65	3·46	4·48	4·33	0·87	2·40	3·13	3·57	3·13
Mean	Ripe Cherry ..	327·75	335·63	152·50	164·75	152·50	250·25	230·5	320·50	229·63	128·13	158·75	216·63	107·63	193·5
	Clean Coffee ..	6·09	6·24	2·84	3·07	4·66	2·83	4·29	5·85	4·38	2·39	2·92	4·03	2·00	3·60

Note.—1. 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.
2. During February 1959, the last of the multiple stems in the first cycle in all the plants under Treatment B was cut and removed. A new sucker is developing for forming one of the multiple stems of the second cycle.
3. On the aggregate of 8 years yields the multiple stem plots have registered a decrease of 19·2% over the single stem plots.

Appendix XXV

Yield Data of Multiple Stem vs. *Single Stem System of Growing Coffee—Experiment II*

Locality : Balehonnur (Mysore State).
Variety : Arabica Hybrids.
Treatments : 4 during the year of conversion.
Replications : 4.
Shade : Natural Shade.
Area of the Experimental Block : 105·8 cents.
Layout : Randomized Blocks.
Plot : 4×16 = 64 plants.
Spacing : 6′×6′.
Age of Plants : 26 years from seed.
Period of Conversion : March 1951.
Treatments :

A. Single stem.
B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers, for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.
C. Extended centring upto one foot from the centre was done during the year of conversion, March 1951, to facilitate free growth of three suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level, retaining a primary branch to form the lung branch. The three suckers form the multiple stems.
D. Except the two top primary branches, all the other branches were cut down during the year of conversion, March 1951, to facilitate the free growth of three suckers. After crop harvest, during March 1952, the topmost primary branch was retained to act as a lung branch and the three suckers form the multiple stems.

Mean Yield of ripe cherry (actual) in lb. and calculated yield of clean coffee, in cwt. per acre (1,200 plants)

Treatments	Ripe Cherry (Actual)								Clean Coffee (Calculated)								Mean of 8 years cwt.
	1952* lb.	1953 lb.	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.	1959 lb.	1952* cwt.	1953 cwt.	1954 cwt.	1955 cwt.	1956 cwt.	1957 cwt.	1958 cwt.	1959 cwt.	
A	38·63	47·14	208·46	100·44	190·83	393·70	256·9	76·75	1·08	1·31	5·81	2·80	5·32	10·98	7·17	2·14	4·58
B	22·11	12·24	262·16	92·31	192·90	388·90	222·6	93·63	0·62	0·34	7·31	2·58	5·40	10·85	6·21	2·61	4·49
C	24·62	26·11	272·46	110·06	251·00	380·00	267·70	33·19	0·68	0·73	7·66	3·07	7·00	10·60	7·47	0·93	4·77
D	38·38	34·73	246·84	99·38	225·49	371·00	257·25	50·00	1·07	0·97	6·77	2·77	6·29	10·35	7·18	1·40	4·60

* Crop of the year of conversion.

Note.—(1) 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.
(2) During February 1959, the last of the multiple stems in the first cycle in all the plants under Treatments B, C and D was cut and removed. A new sucker is developing for forming one of the multiple stems of the second cycle.
(3) On the aggregate of 8 years yields, Treatment B has registered a decrease of 2% over that of the single stem (Treatment A), while Treatments C and D have registered an increase of 4·1% and 0·4% respectively over the single stem.

Appendix XXVI

Yield Data of Multiple Stem vs. *Single Stem System of Growing Coffee—Experiment III*

Locality: Balehonnur (Mysore State).

Variety: Arabica Hybrids.

Treatments: 2: (A). Single Stem; B. Multiple Stem.

Replications: 21.

Area of Experimental Block: 52 cents.

Lay-out: AB, AB Pattern.

Plot: 16 plants in a row.

Spacing: 6′×6′.

Age of plants: 15 years from seed.

Shade: Natural shade.

Period of Conevsion: March 1951.

Mean yield of ripe cherry (actual) in lb. and calculated clean coffee in cwt. per acre (1,200 plants)

Treatments	Ripe Cherry (Actual)—lb.									Clean Coffee—cwt.								
	1952*	1953	1954	1955	1956	1957	1958	1959	Mean	1952*	1953	1954	1955	1956	1957	1958	1959	Mean
A	5·78	19·43	24·72	18·99	11·94	39·29	15·00	40·71	21·98	0·64	2·17	2·76	2·12	1·32	4·38	1·67	4·54	2·45
B	3·90	8·03	21·49	15·20	24·82	42·27	18·24	32·81	20·85	0·44	0·89	2·40	1·69	2·80	4·72	2·04	3·66	2·33

* Crop of the year of conversion.

Note.—(1) 6 lb. of Ripe Cherry has been taken to yield 1 lb. of clean coffee.

(2) During February 1959, the last of the multiple stems in the first cycle in all the plants under Treatment B were cut and removed. A new sucker is developing for forming one of the multiple stems for the second cycle.

(3) On the aggregate of 8 years yield, the multiple stem plots have registered a decrease of 5·1% over that of the single stem plots.

Appendix XXVII

Yield Data of Multiple Stem vs. *Single Stem System of Growing Coffee*

Locality : Balehonnur, Mysore State.

Variety : Robusta.

Treatments : 2.

Lay-out : Opposite quadrants on a rectangular block are on each of the two treatments.

A. Single Stem; B. Multiple Stem. *Shade :* Natural shade.

Spacing : 9′×9′.

Replications : 2.

Period of Conversion : September 1951.

Area of Experimental Block : 65·50 cents.

Age of Plants : 13 years from seed.

Mean yield of ripe cherry per plot (actual) in lb. and calculated yield of clean coffee in cwt. per acre (538 plants)

Year	Description of the Crop	Ripe cherry in lb. and clean coffee in cwt./acre	
		A. Single Stem	B. Multiple Stem
1953	Ripe Cherry	121·06	52·69
	Clean Coffee	1·33	0·58
1954	Ripe Cherry	110·30	153·63
	Clean Coffee	1·20	1·61
1955	Ripe Cherry	138·00	105·34
	Clean Coffee	1·50	1·15
1956	Ripe Cherry	312·00	213·5
	Clean Coffee	3·41	2·35
1957	Ripe Cherry	394·00	136·00
	Clean Coffee	4·30	1·49
1958	Ripe Cherry	229·63	168·00
	Clean Coffee	2·51	1·83
1959	Ripe Cherry	484·50	367·00
	Clean Coffee	5·29	4·01
Mean	Ripe Cherry	255·64	170·88
	Clean Coffee	2·79	1·86

Note.—(1) 5 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.

(2) New suckers are developing on the plants for the second cycle.

(3) On the aggregate of 7 years yields the single stem plots have registered an increase of 50% over the multiple stem plots.

Appendix XXVIII

Arabica Varietal Trial at the Coffee Research Sub-Station, Chethalli P.O., Coorg (Mysore State)

Locality: Chethalli, Coorg (Mysore State).
Treatments: 4: A. S.446; B. S.795; C. S.645; D.S.288.
Shade: Natural Shade.
Layout: Latin square.

Size of Plots: 12×8 = 96 plants.
Spacing: $6\frac{1}{2}' \times 6\frac{1}{2}'$.
Planted: 1949.
Area of Experimental Block: 1·49 acres.

Yield per acre of ripe cherry in lb. and calculated yiled of clean coffee in cwt. per acre

Year	Description of Crop	Yield of ripe cherry in lb. and clean coffee in cwt./acre				Mean	S.E.M.%	Significant or not	Critical Difference	Conclusions
		A	B	C	D					
		S.446	S.795	S.645	S.288					
1952	Ripe Cherry	875	255	193	133	364	23·48	Yes	191	A B C D
	Clean Coffee	1·30	0·38	0·29	0·20	0·54	..	..	0·43	
1953	Ripe Cherry	3746	1897	1366	808	1954	16·22	Yes	1095	A B C D
	Clean Coffee	5·57	2·82	2·03	1·20	2·91	..	..	1·63	
1954	Ripe Cherry	1541	3402	2478	1498	2230	14·18	Yes	1096	B C A D
	Clean Coffee	2·29	5·06	3·69	2·23	3·32	..	..	1·63	
1955	Ripe Cherry	6939	9043	4865	4404	6313	..	Yes	..	B A C D
	Clean Coffee	8·84	13·46	7·24	6·55	9·02	..	..	..	
1956	Ripe Cherry	1997	8551	5821	4259	5157	..	Yes	..	B C D A
	Clean Coffee	3·00	12·70	8·60	6·30	7·65	..	..	..	
1957	Ripe Cherry	9208	10548	9422	8765	9486	..	No	..	B C A D
	Clean Coffee	13·70	15·70	14·02	13·04	14·12	..	..	..	
1958	Ripe Cherry	3000	15838	12584	8872	10074	9·21	Yes	2378	B C D A
	Clean Coffee	4·58	23·55	18·75	13·22	15·03	..	..	3·39	
1959	Ripe Cherry	3991	4200	4638	3974	4201	..	No	..	C B A D
	Clean Coffee	6·00	6·20	6·9	5·9	6·2	..	..	..	

Appendix XXIX

Studies on the Essential Requirements of Plant Foods N.P.K. for Coffee in Relation to Improvement in Yield

New Manurial Series: Yield record and percentage of floats in the harvest

Area of Experimental Plot : 76 cents. *Started in :* 1937.
No. of Plants per Sub-Plot : 5×8=40 (up to January 1955). *Lay-out :* Latin Square. *Treatments :* 5. *Replications:* 5.
No. of Plants per Sub-Plot : 5×4 = 20 (from January 1955). *Spacing :* 5′×5′ (up to January 1955).
Shade : Artificial, Bamboo seats on pandal. *Spacing :* Along the rows: 10′. Along the diagonal: 7′.
Annual Rate of Manuring: Nitrogen 60 lb. to the acre in three equal doses. Phosphoric acid 30 lb. to the acre in two equal doses. Potash: 40 lb. to the acre in two equal doses.

Year and Particulars	Average yield of ripe cherry in lb. and clean coffee in cwt. calculated to the acre. Percentage of floats in the harvest — Treatments					Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
	A N	B NP	C NK	D NPK	E Control				
1958 Cherry	2582	3889	2696	3154	2334	7·87	603	Yes	BD CA E
1959 Cherry..	5686	6274	5531	6038	5172	6·64	1181	No	BDACE
1958 Clean Coffee	3·65	4·74	3·72	4·38	3·14	8·37	1·02	Yes	BD CA E
1959 Clean Coffee	7·81	8·61	7·15	8·10	6·71	3·38	2·19	No	BDACE
Cherry 1945–46 to 1948–49 (20 : 30 : 40 ratio), Average of 4 years ..	408	544	476	578	510	6·67	102	Yes	DBECA
Cherry—1950–51 to 1953–54 (40 : 30 : 40 ratio), Average of 4 years	1139	1054	1173	1156	1003	12·83	442	No	CDABE
Cherry—1955–56 to 1958–59 (60 : 30 : 40 ratio), Average of 4 years	3456	4289	3415	3963	3080	3·67	384	Yes	BDACE
1958 Percentage of floats by weight ..	8·26	9·64	9·42	8·70	8·12	8·20	2·23	No	BCDAE
1959 ,, ,, volume ..	8·40	10·36	10·22	8·96	8·66	9·69	2·78	No	BCDEA
1959 ,, ,, weight ..	8·60	9·80	9·50	9·52	9·74	5·65	1·64	No	BEDCA
1959 ,, ,, volume ..	9·22	10·94	10·42	9·90	10·50	6·89	2·16	No	BECDA

APPENDIX XXX

NPK Trials with Varying Levels of N.P.K. Fundamental Manurial Experiments in the pH Cisterns

Yield record and percentage of floats in the harvest

Area of Experimental Plot : 25 cents. *Lay-out :* Latin Square. *Treatments :* 6. *Replications :* 6.
No. of Plants per Sub-Plot : 1. *Spacing :* 7½'. *Started in* 1950.
Shade : Artificial coir matting over pandal.
Annual Rate of Manuring :

A.	20 lb. Nitrogen +	30 lb. Phosphoric acid +	40 lb. Potash to the acre
B.	30 ,, ,,	30 ,, ,,	40 ,, ,, ,,
C.	45 ,, ,,	30 ,, ,,	40 ,, ,, ,,
D.	30 ,, ,,	45 ,, ,,	40 ,, ,, ,,
E.	30 ,, ,,	45 ,, ,,	60 ,, ,, ,,
F.	45 ,, ,,	67·5 ,, ,,	90 ,, ,, ,,

Year and Particulars	Average yield of ripe cherry and clean coffee in lb. per plot and percentage of floats — Treatments						Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
	A	B	C	D	E	F				
1958 Cherry	2·40	2·03	4·04	2·26	2·85	2·69	25·65	2·05	No	$\overline{CEFADB}$
1958 Clean Coffee	0·39	0·34	0·61	0·37	0·45	0·46	26·59	0·33	No	$\overline{CEFADB}$
1959 Cherry	3·43	2·32	3·10	3·12	2·18	1·43	22·42	1·72	No	$\overline{ADCBEF}$
1959 Clean Coffee	0·45	0·30	0·41	0·42	0·29	0·18	22·77	0·23	No	$\overline{ADCBEF}$
Average Cherry for 6 years ..	2·43	1·75	2·42	1·81	1·82	2·28	15·88	1·07	No	$\overline{ACFDEB}$
Average Clean Coffee for 6 years	0·38	0·28	0·37	0·28	0·29	0·36	15·92	0·15	No	$\overline{ACFEDB}$
1958 Floats by weight ..	18·39	18·70	19·35	21·30	18·85	16·13	7·69	4·26	No	$\overline{DCEBAF}$
1958 Floats by volume ..	23·25	24·25	22·63	29·31	26·33	20·78	10·76	7·76	No	$\overline{DEBACF}$
1959 Floats by weight ..	19·69	18·01	19·29	21·66	19·86	22·28	8·72	5·19	No	$\overline{FDEACB}$
1959 Floats by volume ..	20·62	18·44	20·17	22·21	21·71	21·77	8·82	5·42	No	$\overline{DFEACB}$

Appendix XXXI

Studies on the Effect of Varying Doses of Nitrogen with Constant Levels of P_2O_5 and K_2O on the Growth and Yield of Coffee : Yield Record

Area of Experimental Plot : 1·13 acres. *Lay-out :* Latin Square. *Treatments :* 5. *Replications :* 5.

No. of Plants per Sub-Plot : Gross: 7×7 = 49; Net: 5×5=25. *Variety of Coffee :* Nett: Kent's Clones. Inner border rows : Kent's Seedlings. Guard rows : S. 983 Seedlings.

Annual Rate of Manuring :

A. Control—No Manure.
B. 80 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre per annum.
C. 100 ,, ,, 30 ,, ,, 40 ,, ,, ,,
D. 60 ,, ,, 30 ,, ,, 40 ,, ,, ,,
E. 40 ,, ,, 30 ,, ,, 40 ,, ,, ,,

Year and Particulars	Average yield of ripe cherry in lb. and clean coffee in cwt. calculated to the acre — Treatments					Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
	A	B	C	D	E				
1958 Ripe Cherry ..	1257	2646	1778	2007	2266	17·99	1103	No	$\overline{\text{BEDCA}}$
1959 Ripe Cherry ..	1459	1565	1800	1210	1877	21·31	1039	No	$\overline{\text{ECBAD}}$
Average of 3 years (Cherry)	1060	1614	1424	1188	1532	14·22	612	No	$\overline{\text{BECDA}}$

Appendix XXXII

Studies on the Effect of Different Sources of Nitrogen on the Growth and Yield of Coffee
Yield Record: 1958–59

Area of Experimental Plot : 0·98 acre. *Lay-out :* Latin Square. *Treatments :* 5. *Replications :* 5.

No. of Plants per Sub-Plot : Gross: 7×6=42; Nett: 5×4 = 20. *Spacing :* 6′×6′. *Shade :* Natural mixed shade.

Planted: 1953.

Annual Rate of Manuring : Nitrogen 80 lb. to the acre applied in 3 doses: (1) Pre-blossom 30 lb., (2) Post-blossom 20 lb. and (3) Post-monsoon 30 lb.
Phosphoric acid 30 lb. to the acre } To be applied in two equal doses (Pre-blossom and Post-monsoon).
Potash 40 lb. to the acre }

Treatments :

A. Required quantity of Nitrogen applied as Chilean Nitrate.
B. Control (No Manure).
C. Required quantity of Nitrogen applied as Calcium Ammonium Nitrate.
D. ,, ,, ,, Urea.
E. ,, ,, ,, Ammonium Sulphate.

Treatments	Yield of ripe cherry in lb. per plot — Replications					Mean	Calculated yield per acre	Standard error as % of gen. mean	Critical difference P = 0·05	Significant or not	Conclusions
	1	2	3	4	5						
A	38·8	24·7	41·5	29·8	10·5	29·0	1740				
B	78·5	27·7	51·5	50·6	50·9	51·8	3108				
C	31·8	91·8	36·2	49·1	81·8	58·1	3486	20·50	30·75	No	$\overline{\text{CDBEA}}$
D	67·0	36·5	48·6	84·5	45·5	56·4	3384				
E	25·0	87·5	54·8	50·8	21·7	47·9	2874				

Appendix XXXIII

N.P.K. Trials with Varying Levels and Combinations (Arabica Manurial Experiments) at the Coffee Research Sub-Station, Chethalli, Coorg

Yield Data 1958–59

Area of Experimental Plot : 2·28 acres. *Lay-out :* Factorial design 4×2×2.

No. of Plants per Sub-plot : Gross: 7×7=49. *Replications :* 3.

Nett: 5×5=25. *Planted :* 6½×6½′.

Variety of Coffee : S. 446 2nd generation. *Shade :* Natural mixed shade.

Terraced and Planted in : August 1952. 1st *Manuring :* May 1953.

Treatments : Nitrogen at 4 levels N_0, N_1, N_2 and N_3.
N_0 = 0 lb. N; N_1 = 60 lb. N; N_2 = 90 lb. N; N_3 = 120 lb. N per acre.
Phosphoric acid at 2 levels P_0 and P_1.
P_0 = 0 lb. P_2O_5; P_1 = 30 lb. P_2O_5 per acre.
Potash at 2 levels K_0 and K_1.
K_0 = 0 lb. K_2O; K_1 = 40 lb. K_2O per acre.

Tables of Mean Yields in lb. per Plant

	N_0	N_1	N_2	N_3	Mean
P_0	14·02	13·42	15·70	9·84	2·21
P_1	13·17	19·00	15·88	18·18	2·76
Mean	2·10	2·70	2·63	2·34	

S.E. for Nitrogen Plots = 0·23; S.E. for Phosphoric Acid Plots = 0·17.

	N_0	N_1	N_2	N_3	Mean
K_0	14·97	15·31	17·39	14·96	2·61
K_1	12·22	17·11	14·19	13·06	2·36
Mean	2·10	2·70	2·63	2·34	

S.E. for Nitrogen Plots = 0·23; S.E. for Potash Plots = 0·17.

	K_0	K_1	Mean
P_0	26·06	26·92	2·21
P_1	36·57	29·66	2·76
Mean	2·61	2·36	

S.E. for Potash Plots = 0·17. S.E. for Phosphoric Acid Plots = 0·17. Factor P only is significant. Critical difference for P as P = 0·05 = 0·48.

Appendix XXXIV

Studies on the Effect of Aldrinized Fertilisers on the Yield of Coffee : Yield Record

Area of Experimental Plot : 0·60 acres. *Lay-out :* Randomized Block. *Treatments :* 4. *Replications :* 6.

No. of Plants per Sub-Plot : 6×5 = 30. *Spacing :* 6′×6′. *Shade :* Natural mixed shade. *Started:* 1955.

Annual Rate of Manuring :

A. 440 lb. of fertilizer mixture to the acre per year to give 80 lb.N., 45 lb. P_2O_5 and 60 lb. K_2O to be applied in three equal doses during: (1) Pre-monsoon, (2) Post-blossom—Pre-monsoon, (3) Post-monsoon.

B. Same as in (A) above + 2·25 lb. of Aldrin.

C. ,, ,, ,, + 1·5 ,, ,,

D. ,, ,, ,, + 1·0 ,, ,,

Year and Particulars	Average yield of ripe cherry in lb. calculated to the acre — Treatments				Standard error as % of gen. mean	Critical difference as P=0·05	Significant or not	Conclusions
	A	B	C	D				
Coffee Research Station, Balehonnur								
1958 Ripe Cherry ..	3751	3166	3354	3928	11·91	1274	No	$\overline{DACB}$
1959 Ripe Cherry ..	2352	2132	2544	2112	10·30	700	No	$\overline{CABD}$
Coffee Research Sub-station, Chethalli								
1958 Ripe Cherry ..	3660	3047	4067	3567	15·60	1684	No	$\overline{CADB}$
1959 Ripe Cherry ..	2536	2764	2492	3568	16·82	1158	No	$\overline{DBAC}$

Appendix XXXV

Field Trials to find out the Maximum Economic Dose of Nitrogen and the Role of Phosphates and Potash in Balancing the Nitrogen Utilization: Yield Record

Lay-out: Randomized split plot. *Treatments:* Main 6; Sub. 4. *Replications:* 3.

Spacing: 5′×5′. *Shade:* Natural mixed shade. *Started:* May 1956.

Treatments: Main 6—with 6 levels of Nitrogen from 0 lb. to 800 lb. to the acre annually with and without Phosphoric acid and Potash

A. 50 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre.
B. 800 ,, ,, + 360 ,, ,, + 480 ,, ,, ,,
C. 200 ,, ,, + 90 ,, ,, + 120 ,, ,, ,,
D. 0 ,, ,, + 0 ,, ,, + 0 ,, ,, ,, (Control)
E. 400 ,, ,, + 180 ,, ,, + 240 ,, ,, ,,
F. 100 ,, ,, + 45 ,, ,, + 60 ,, ,, ,,

Sub-Treatments:

1. Nitrogen with Phosphoric acid and Potash.
2. As in (one) + basal dressing of 1 lb. of finely ground rock phosphate per plant applied at the commencement of the experiment.
3. Nitrogen only + basal dressing of rock phosphate applied as above.
4. Nitrogen only.

Time and Method of Application:

50 lb. Nitrogen level given in two equated doses in March and October while all the rest are given in four equal doses in March May, August and October—applied as a broad band within the drip circle of each plant under the leaf mulch.

Main Treatments	Yield of ripe cherry in lb. per plot of 9 plants (Totals of 3 replications)				Mean of main treatments	Standard error		Critical difference P=0·05		Significant or not		Conclusions
	Sub-Treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	1	2	3	4								
1958												
A	35·7	44·9	37·8	41·5	13·33							
B	50·8	40·8	66·0	58·4	18·00							
C	49·1	107·7	51·5	62·8	22·60	10·09	6·53	4·45	4·29	Yes	No	Main: $\overline{CBFDAE}$ Sub.: $\overline{2431}$
D	35·6	37·6	44·9	50·0	14·01							
E	32·0	41·4	44·2	32·1	12·48							
F	35·8	42·6	44·4	49·2	14·33							
Mean of Sub-Treatments	13·3	17·5	16·1	16·3								
1959												
A	93·2	107·6	102·7	96·6	33·30							
B	122·1	119·5	129·9	118·2	40·80							
C	118·4	89·2	123·3	144·0	39·60	17·47	5·56	16·26	3·62	No	No	Main: $\overline{FBCDEA}$ Sub: $\overline{4312}$
D	119·3	120·8	110·3	109·5	38·30							
E	117·4	79·4	109·7	105·1	34·30							
F	100·9	135·9	129·6	135·0	41·80							
Mean of Sub-Treatments	37·30	36·20	39·20	39·40								

Appendix XXXVI

Studies on the Application of Nitrogen only in Divided Doses in Relation to Yield of Coffee

Ossoor Manurial Experiments: Yield Record

Locality: Ossoor Estate. *Lay-out:* Randomized Block. *Treatments:* 4.

Area of Experimental Plot: 0·80 acre. *No. of Plants per Plot:* 8×5 = 40. *Spacing:* 6′×6′.

Replications: 6. *Shade:* Natural mixed shade.

Started: June 1953.

Annual Rate of Manuring:

A. 80 lb. Nitrogen only to the acre in one single dose.
B. 80 ,, ,, ,, in two equal doeses of 40 lb. each.
C. 80 ,, ,, ,, in three doses: 30 lb., 20 lb. and 30 lb.
D. Control—No treatment.

Year and Particulars	Average yield of ripe cherry in lb. calculated to the acre				Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
	Treatments							
	A	B	C	D				
1958 Ripe Cherry	3315	3465	3621	3351	4·42	578	No	$\overline{\text{CBDA}}$
1959 Ripe Cherry	1826	1375	1202	1498	10·71	476	No	$\overline{\text{ADBC}}$
Average for 6 years	2687	2542	2525	2633	5·46	427	No	$\overline{\text{ADBC}}$

Appendix XXXVII

Studies on the Effect of Different Sources of Nitrogen on the Growth and Yield of Mature Yielding Coffee
Yield Record

Locality: Shigode Estate.
Lay-out: Latin Square.
Treatments: 6.
Replications: 6.
No. of Plants per Sub-plot: Gross: $7 \times 10 = 70$; Nett: $5 \times 8 = 40$.
Spacing: $5' \times 5'$.
Shade: Natural mixed shade.
Started: 1956.
Area of Experimental plot: 1·5 acres.

Annual Rate of Manuring:

Nitrogen 80 lb. to the acre applied in three doses.
Phosphoric acid 45 lb. to the acre applied in two equal doses.
Potash 60 lb. to the acre applied in two equal doses.

Treatments:

A. Control—No Manure.
B. Required quantity of Nitrogen applied as Calcium Ammonium Nitrate.
C. ,, ,, ,, ,, Ammonium Sulphate.
D. ,, ,, ,, ,, Urea
E. ,, ,, ,, ,, Chilean Nitrate.
F. ,, ,, ,, ,, Ammonium Sulphate Nitrate.

Year and Particulars	Average yield of ripe cherry in lb. calculated to the acre — Treatments						Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
	A	B	C	D	E	F				
1958 Ripe Cherry ..	2671	2215	2673	2283	2302	2610	11·48	833	No	$\overline{\text{CAFEDB}}$
1959 Ripe Cherry ..	2686	2193	2737	3026	2244	2465	11·26	884	No	$\overline{\text{DCAFEB}}$

Appendix XXXVIII

Field Manurial Trials in Private Estates on Arabica Coffee—Yield Data

Treatments: Main: 4; Sub: 4.
Shade: Natural Mixed Shade.
Started in: 1954.
Main Treatments:

A. Nitrogen at 40 lb. to the acre per annum.
B. ,, 60 ,, ,, ,,
C. ,, 80 ,, ,, ,,
D. ,, 100 ,, ,, ,,

Lay-out: Randomized Split Plot.
No. of Plants per Sub-plot: Gross: $10 \times 7 = 70$. Net: $8 \times 5 = 40$.

Sub-Treatments:

N_1: The required quantity of Nitrogen applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.

N_2: The required quantity of Nitrogen applied in three doses; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon periods.

NP: The required quantity of nitrogen applied as above (N_2) + 30 lb. Phosphoric acid to the acre applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.

NPK: As in NP above + 40 lb. Potash to the acre applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.

Main Treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P=0·05		Significant or not		Conclusions
	Sub-Treatments					Main Plots	Sub-Plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	N_1	N_2	NP	NPK								
Urvinkhan Estate—Mudigere Zone, Mysore. Spacing: 6′×6′. Replications: 2.												
1958 A	11·3	10·5	10·1	11·4	5·4							
B	11·0	9·6	9·9	10·2	5·1							Main: $\overline{A\ B\ C\ D}$
C	10·3	9·4	11·5	9·0	5·0	0·42	0·84	0·67	0·92	No	No	Sub: $\overline{N_1\ NP\ NPK\ N_2}$
D	9·9	10·2	10·3	9·2	5·0							
Mean of Sub-treatments	5·3	5·0	5·3	5·0								
1959 A	3·5	7·3	5·9	4·8	2·7							
B	6·0	4·7	4·0	5·4	2·5							Main: $\overline{D\ A\ B\ C}$
C	4·5	5·3	5·7	4·5	2·5	2·02	0·59	3·21	0·65	No	No	Sub: $\overline{N_2\ NP\ N_1\ NPK}$
D	6·9	7·4	5·8	5·1	3·2							

Karadibetta Estate, Saklespur Zone, Mysore. Spacing: 6′×6′. Replications: 5.

1958	A	5·7	7·6	14·1	11·0	1·9						
	B	5·5	8·2	6·5	7·6	1·4						Main: $\overline{A\ D\ C\ B}$
	C	6·8	7·5	7·1	6·7	1·4	1·00	0·77	0·69	0·48	No	No Sub: $\overline{NPK\ NP\ N_2\ N_1}$
	D	6·8	6·1	8·5	8·7	1·5						
Mean of Sub-treatments		1·2	1·5	1·8	1·7	..						
1959	A	10·7	17·2	14·0	17·3	3·0						
	B	9·6	11·0	11·9	12·6	2·3						Main: $\overline{C\ A\ D\ B}$
	C	14·9	16·0	14·9	17·0	3·1	1·31	0·94	0·90	0·58	No	No Sub: $\overline{NPK\ N_2\ N_1\ NP}$
	D	14·3	14·7	12·5	13·6	2·8						
Mean of Sub-treatments		2·5	3·0	2·2	3·0	..						

Vasambadi Estate, Shevaroys, Madras. Spacing: 5½′×5½′. Replications: 3.

1958	A	4·6	6·6	8·4	5·2	2·1						
	B	5·2	5·4	7·7	6·3	2·1						Main: $\overline{A\ B\ D}$, C
	C	3·7	4·1	3·1	3·7	1·2	0·58	0·62	0·59	0·52	Yes	No Sub: $\overline{NP\ N_2\ NPK\ N_1}$
	D	4·8	6·2	6·0	5·0	1·8						
Mean of Sub-treatments		1·5	1·9	2·1	1·7							
1959	A	14·1	12·3	12·9	10·5	4·2						
	B	11·5	10·6	8·5	9·7	3·4						Main: $\overline{A\ B\ C\ D}$
	C	9·7	9·6	11·2	9·4	3·3	1·17	0·89	1·17	0·75	No	No Sub: $\overline{N_1\ NP\ N_2\ NPK}$
	D	9·7	6·4	10·5	9·0	3·0						
Mean of Sub-treatments		3·8	3·2	3·6	3·2	..						

Coffee Research Sub-Station, Chethalli. Spacing: 6′×6′. Replications: 3.

1958	A	9·8	10·5	10·4	10·2	3·4						
	B	9·3	11·4	11·6	12·2	3·7						Main: $\overline{B\ D\ A\ C}$
	C	8·1	7·1	8·0	8·2	2·6	1·40	0·91	1·40	0·77	No	No Sub: $\overline{NPK\ NP\ N_2\ N_1}$
	D	10·0	8·3	11·4	11·3	3·4						

Main Treatments		Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P=0·05		Significant or not		Conclusions
		Sub-treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
		N_1	N_2	NP	NPK								
Mean of Sub-treatments		3·1	3·1	3·5	3·5	..							
1959	A	6·3	7·5	8·8	5·1	2·3							
	B	6·4	9·4	5·9	4·6	2·2							
	C	10·1	6·8	6·6	6·1	2·5	1·51	1·09	1·51	0·88	No	No	Main: $\overline{CABD}$ Sub: $\overline{N_2 N_1 NP NPK}$
	D	6·4	7·1	4·7	4·1	1·9							
Mean of Sub-treatments		2·4	2·6	2·2	1·6	..							
Merthikhan Estate, North Mysore. Spacing: 6′×6′. Replications: 3.													
1958	A	7·5	6·1	8·7	4·8	2·3							
	B	6·9	8·9	6·4	7·2	2·5							
	C	6·0	5·1	9·2	4·5	2·1	2·13	0·89	2·13	0·74	No	No	Main: $\overline{BDAC}$ Sub: $\overline{NP N_2 N_1 NPK}$
	D	5·0	9·4	6·8	7·4	2·4							
Mean of Sub-treatments		2·1	2·5	2·6	2·0	..							
1959	A	21·0	19·1	17·0	24·0	6·8							
	B	16·7	17·5	21·6	16·8	6·1							
	C	22·0	18·6	23·2	18·9	6·9	1·01	1·08	1·01	0·91	No	No	Main: $\overline{CADB}$ Sub: $\overline{NP NPK N_1 N_2}$
	D	17·6	20·5	21·1	20·2	6·6							
Mean of Sub-treatments		6·4	6·3	6·9	6·7	..							
Togarihankal Estate, Chikmagalur Zone, Mysore. Spacing: 6′×6′. Replications: 3.													
1958	A	11·4	8·7	10·7	10·0	3·4							
	B	19·0	3·3	18·7	3·8	3·7							
	C	10·4	3·1	17·1	11·5	3·5	4·58	3·98	4·58	3·35	No	No	Main: $\overline{DBCA}$ Sub: $\overline{N_1 NP NPK N_2}$
	D	18·3	9·1	11·9	16·4	4·6							

Mean of Sub-treatments		4·9	2·0	4·8	3·5							
1959	A	3·7	7·8	4·7	4·9	1·8						
	B	4·3	2·4	4·8	3·6	1·3						Main: $\overline{D\,A\,B\,C}$
	C	3·6	3·6	3·2	3·6	1·2	0·83	0·61	0·83	0·51	No	No Sub: $\overline{N_2\,N_1\,NPK\,NP}$
	D	6·9	4·8	4·1	5·8	1·8						
Mean of Sub-treatments		1·5	1·6	1·4	1·5	..						
Sulgode Estate, Saklespur Zone. Spacing: 5′×5′. Replications: 3.												
1958	A	9·3	6·4	8·1	9·4	2·8						
	B	8·6	6·2	7·6	6·6	2·4						Main: $\overline{D\,C\,A\,B}$
	C	9·4	7·9	7·4	8·7	2·6	0·59	0·58	0·59	0·49	No	No Sub: $\overline{NPK\,N_1\,NPN_2}$
	D	6·7	11·7	9·6	8·7	3·0						
Mean of Sub-treatments		2·8	2·7	2·7	2·8	..						
1959	A	1·5	3·0	1·5	1·8	0·7						
	B	2·5	1·7	1·2	3·1	0·7						Main: $\overline{C\,D\,B\,A}$
	C	2·8	1·6	2·6	3·4	0·9	0·58	0·50	0·58	0·42	No	No Sub: $\overline{NPK\,N_2\,N_1\,NP}$
	D	1·5	2·8	2·8	2·7	0·8						
Mean of Sub-treatments		0·7	0·8	0·7	0·9	..						
Maruvahulla Estate, Kotagiri, Nilgiris. Spacing: 6′×6′. Replications: 3.												
1958	A	8·5	6·3	7·5	6·2	2·4						
	B	5·1	7·0	4·5	8·6	2·1						Main: $\overline{C\,D\,A\,B}$
	C	9·4	7·6	8·5	8·1	2·8	1·01	0·67	1·01	0·57	No	No Sub: $\overline{N_1\,NP\,NPK\,N_2}$
	D	8·9	6·4	7·7	5·3	2·4						
Mean of Sub-treatments		2·6	2·3	2·4	2·4	..						
1959	A	2·2	1·4	1·7	3·2	0·7						
	B	2·0	2·1	1·5	2·7	0·7						Main: $\overline{A\,B\,C\,D}$
	C	1·0	0·8	0·9	0·9	0·3	0·71	0·30	0·71	0·26	No	No Sub: $\overline{NPK\,N_1\,N_2NP}$
	D	1·6	1·2	1·3	0·8	0	·4					
Mean of Sub-treatments		0·6	0·5	0·5	0·6	..						

APPENDIX XXXIX

Field Manurial Trials in Private Estates, Arabica

Yield of cherry expressed as percentage of the means of N_1 and N_2

	Treatments	Merthi-khan	Urvin-khan	Sulgode	Karadi-betta	Togari-hankal	Vasambadi	Maruva-halla	C.R.S.S.	Mean of 8 estates
A.	40 lb. N_2, N ..	100	100	100	100	100	100	100	100	100
	40 ,, ,, NP ..	188	116	114	101	68	98	90	128	100·3
	40 ,, ,, NPK ..	118	87	131	124	71	80	177	75	107·8
B.	60 ,, ,, N ..	100	100	100	100	100	100	100	100	100
	60 ,, ,, NP ..	129	75	61	115	146	77	109	103	101·9
	60 ,, ,, NPK ..	102	100	149	123	110	88	137	79	110·9
C.	80 ,, ,, N ..	100	100	100	100	100	100	100	100	100
	80 ,, ,, NP ..	114	117	120	97	87	118	105	173	103·7
	80 ,, ,, NPK ..	95	92	157	110	101	96	116	67	104·1
D.	100 ,, ,, N ..	100	100	100	100	100	100	100	100	100
	100 ,, ,, NP ..	108	79	134	87	71	131	91	70	96·4
	100 ,, ,, NPK ..	108	71	123	94	98	112	54	62	90·2

APPENDIX XL

Robusta Field Manurial Trials in Private Estates—Yield Data

Treatments: Main: 4. Sub: 4. *Lay-out:* Randomized split plot. *Shade:* Natural mixed shade.
No. of Plants per Sub-Plot: Gross: $7\times6=42$; Nett: $5\times4=20$. *Started:* In 1955.

Main Treatments:

A. Nitrogen at 40 lb. to the acre per annum.
B. ,, 60 ,, ,, ,,
C. ,, 80 ,, ,, ,,
D. ,, 100 ,, ,, ,,

Sub-Treatments:

N_1: The required quantity of Nitrogen applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.

N_2: The required quantity of nitrogen applied in three doses; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon season.

NP: The required quantity of Nitrogen applied as above (N_2) + 30 lb. Phosphoric acid to the acre applied in two equal doses once in pre-blossom and once in the post-monsoon season.

NPK: As in NP above + 40 lb. Potash to the acre applied in two equal doses once in pre-blossom and once in the post-monsoon season.

Main Treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P=0·05		Significant or not		Conclusions
	Sub-treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	N_1	N_2	NP	NPK								
Sulgode Estate, Saklespur Zone, Mysore. Spacing: 10′×10′. Replications: 3.												
1958 A	57·4	51·1	55·2	51·9	18·0							
B	51·0	54·9	52·9	53·5	17·7							Main: $\overline{\text{D A B C}}$
C	45·4	50·8	60·0	55·8	17·5	2·47	2·47	2·47	2·28	No	No	Sub: $\overline{\text{NP NPK N}_2\ \text{N}_1}$
D	55·1	54·9	65·0	69·6	20·4							
Mean of Sub-treatments	17·4	17·6	19·4	19·2								
1959 A	33·9	29·4	26·3	31·0	10·1							
B	32·2	28·0	28·1	39·5	10·7							Main: $\overline{\text{B A}}\ \overline{\text{C D}}$
C	21·9	26·5	19·5	30·3	8·2	2·08	3·00	2·08	2·53	Yes	No	Sub: $\overline{\text{NPK N}_1\ \text{N}_2\ \text{NP}}$
D	17·8	20·1	23·7	28·7	7·5							
Mean of Sub-treatments	8·8	8·7	8·1	10·8								

Appendix XL (*Contd.*)

Main Treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P=0·05		Significant or not		Conclusions
	Sub-treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	N_1	N_2	NP	NPK								
Chellote Estate, Kalpetta, Wynaad. Spacing: 10′×10′. Replications: 2.												
1958 A	8·9	10·6	12·9	13·7	5·8							
B	7·4	12·4	11·0	12·3	5·4							Main: $\overline{A\ B\ C\ D}$
C	8·9	8·1	7·1	12·3	4·6	1·79	1·52	2·84	1·65	No	No	Sub: $\overline{NPK\ NP\ N_2\ N_1}$
D	7·4	7·4	8·1	10·6	4·2							
Mean of Sub-treatments	4·1	4·8	4·9	6·1	..							
1959 A	17·2	20·7	16·5	20·9	9·4							
B	15·7	25·1	22·8	22·6	10·8							Main: $\overline{B\ A\ C\ D}$
C	14·1	13·0	16·6	16·6	7·5	1·84	1·71	2·92	1·87	No	No	Sub: $\overline{NPK\ N_2\ NP\ N_1}$
D	13·5	12·0	14·0	18·6	7·3							
Mean of Sub-treatments	7·6	8·9	8·7	9·8								
North Carolina Estate, Kalpetta, Wynaad. Spacing: Replications I and II 10′×10′; Replication III 9′×9′. Replications 3.												
1958 A	11·9	12·0	9·5	14·9	4·0							
B	11·4	10·0	10·0	13·9	3·8							Main: $\overline{D\ C\ A\ B}$
C	16·1	12·5	15·0	19·2	5·2	2·26	1·53	2·26	1·30	No	Yes	Sub: $\overline{NPK\ N_1\ NP\ N_2}$
D	18·7	14·8	16·1	21·6	5·9							
Mean of sub-treatments	4·8	4·1	4·2	5·8								
1959 A	40·3	30·2	34·0	38·5	12·8							
B	46·1	39·9	38·5	40·1	13·7							Main: $\overline{D\ C\ B\ A}$
C	46·8	51·2	49·7	40·9	15·7	4·60	3·32	4·60	2·80	No	No	Sub: $\overline{NPK\ N_1\ NP\ N_2}$
D	46·2	50·3	55·8	66·2	18·2							
Mean of sub-treatments	15·0	14·3	14·9	15·5								

Krishna Estate, Kalpetta, Wynaad. Spacing: 9′×9. Replications: 3.

1958	A	16·2	11·4	15·3	13·0	4·7						
	B	12·0	12·2	8·9	13·6	3·9						Main: $\overline{A\ D\ B\ C}$
	C	9·7	12·8	7·7	14·9	3·8	1·35	1·31	1·35	1·10	No	No Sub: $\overline{NPK\ N_2\ N_1\ NP}$
	D	8·8	16·4	14·5	15·1	4·6						
Mean of Sub-treatments		3·9	4·4	3·9	4·7							
1959	A	17·3	16·2	20·6	17·4	5·9						
	B	22·4	20·7	18·3	21·0	6·9						Main: $\overline{B\ C\ D\ A}$
	C	17·9	18·0	22·0	16·4	6·2	2·80	1·20	2·80	1·01	No	No Sub: $\overline{NP\ N_1\ N_2\ NPK}$
	D	15·1	21·1	21·2	15·5	6·1						
Mean of Sub-treatmnets		6·1	6·3	6·8	5·9							

Pathripara Estate, Kalpetta, Wynaad. Spacing: 9′×9′. Replications: 3.

1958	A	15·4	13·2	15·1	17·4	5·1						
	B	16·2	13·8	16·6	11·4	4·8						Main: $\overline{D\ C\ A\ B}$
	C	16·9	12·8	14·4	17·6	5·2	1·38	0·90	1·38	0·73	No	No Sub: $\overline{NPK\ N_1\ NP\ N_2}$
	D	16·5	18·3	13·2	19·1	5·6						
Mean of Sub-treatments		5·4	4·8	4·9	5·5							
1959	A	34·2	35·5	30·0	55·1	12·9						
	B	35·8	41·3	43·3	32·7	12·8						Main: $\overline{D\ A\ B\ C}$
	C	46·2	28·2	34·3	29·1	11·5	4·96	3·15	4·96	2·66	No	No Sub: $\overline{NPK\ NP\ N_1\ N_2}$
	D	34·3	44·0	46·3	68·0	16·1						
Mean of Sub-treatments		12·5	12·4	12·8	15·4							

Appendix XLI

Modified Robusta Manurial Trials laid out in Private Estates—Yield Data—Series I

Lay-out : Latin Square. *Treatments :* 6. *Replications :* 6.
Shade : Natural mixed shade. *Started :* 1956.
No. of Plants per Sub-Plot : Nett: 5×4=20 with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.

Treatments :

A. 40 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre per annum
B. 60 ,, ,, + 30 ,, ,, ,, + 40 ,, ,, ,, ,,
C. 60 ,, ,, + 45 ,, ,, ,, + 60 ,, ,, ,, ,,
D. 80 ,, ,, + 60 ,, ,, ,, + 80 ,, ,, ,, ,,
E. 60 ,, ,, + 60 ,, ,, ,, + 80 ,, ,, ,, ,,
F. 40 ,, ,, + 60 ,, ,, ,, + 80 ,, ,, ,, ,,

A basal dressing of 10 cwt. of finely ground Rock Phosphate was applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of Application of Fertilizers :
Nitrogen applied in three doses once in the pre-blossom, once in the post-monssom and once in the post-monsoon period. Phosphoric acid and Potash applied in two doses during the pre-blossom and post-monsoon periods.

	Name of the Estates	Average yield of ripe cherry in lb. calculated to the acre — Treatments A	B	C	D	E	F	Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
1958											
1.	Cheekanahally Estate, Saklespur ..	3179	2730	3010	2342	2955	3120	14·13	1231	No	$\overline{AFCEBD}$
2.	Harley Estate, Saklespur	1330	2552	2208	2040	2146	2267	49·71	1292	No	$\overline{BFCEDA}$
3.	Panchura Estate, Kalpetta, Wynaad ..	2106	2496	2671	2205	2496	2944	67·28	2174	No	$\overline{FCBEDA}$
4.	Maniangode Estate, Kalpetta, Wynaad	2843	3118	3409	3134	3391	2989	9·46	875	No	$\overline{CEDBFA}$
5.	Huvinkadu Estate, South Coorg ..	4906	3281	3075	3428	2864	3922	16·34	702	Yes	$A\overline{FDBCE}$
6.	Yemmegundi Estate, South Coorg ..	2015	1656	2036	1722	1969	1832	17·32	959	No	$\overline{CAEFDB}$
7.	Bankal Estate, Mudegere	3983	3756	2872	3418	3054	3347	29·78	1203	No	$\overline{ABDFEC}$
1959											
1.	Cheekanahally Estate, Saklespur ..	5712	5032	4080	5236	5712	4488	15·04	2230	No	$\overline{AEDBFC}$
2.	Harley Estate, Saklespur	2924	3604	3468	3536	2788	3468	13·99	1259	No	$\overline{BDFCAE}$
3.	Panchura Estate, Kalpetta, Wynaad ..	4788	4304	4465	4358	4304	3981	11·12	1431	No	$\overline{ACDEBF}$
4.	Maniangode Estate, Kalpetta, Wynaad	1933	1890	2079	1582	1901	1890	8·62	464	No	$\overline{CAEBFD}$
5.	Huvinkadu Estate, South Coorg ..	4896	4964	4148	4488	4896	4488	8·61	1176	No	$\overline{BAEDFC}$
6.	Yemmegundi Estate, South Coorg ..	4624	4216	3876	4352	4284	4284	7·75	972	No	$\overline{ADEFBC}$
7.	Bankal Estate, Mudegere	9588	7752	8908	8432	10200	10200	7·99	2169	No	$\overline{EFACDB}$

APPENDIX XLII

Modified Robusta Manurial Trials laid out in Private Estates—Yield Data—Series II

Lay-out: Latin Square. *Treatments:* 6. *Replications:* 6.
Shade: Natural mixed shede.
Started: 1956.
No. of Plants per Sub-Plot: Nett: 5×4=20 with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.

Treatments:

A. N only at 60 lb. per acre applied as Ammonium Sulphate.
B. N as above + 45 lb. P_2O_5 per acre applied as Hyperphosphate Reno.
C. N as above + 60 lb. K_2O per acre applied as Muriate of Potash.
D. P_5O_5 at 45 lb. per acre + 60 lb. K_2O per acre applied as Hyperphosphate Reno and Muriate of Potash respectively.
E. As in Treatment B above + 60 lb. K_2O per acre applied as Muriate of Potash.
F. Control (no treatment).

A basal dressing of 10 cwt. of finely ground agricultural lime-stone was applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of applications of Fertilizers: Nitrogen applied in three doses: during the pre-blossom, post-blossom and post-monsoon periods. P_2O_5 and K_2O applied in two equal doses during the pre-blossom and post-monsoon periods.

	Name of the Estate	Average yield of ripe cherry in lb. calculated to the acre — Treatments A	B	C	D	E	F	Standard error as % of gen. mean	Critical difference P=0·05	Significant or not	Conclusions
1958											
1.	Cheekanahally Estate, Saklespur ..	4108	2649	2975	3576	4056	3345	13·50	972	Yes	$\overline{AEDFCB}$
2.	Harley Estate, Saklespur	1861	2414	1966	2150	2095	1769	30·97	782	No	$\overline{BDECAF}$
3.	Panchura Estate, Kalpetta, Wynaad ..	2286	1383	2495	3732	2822	2891	17·92	1380	Yes	$\overline{DFECAB}$
4.	Maniangode Estate, Kalpetta, Wynaad	3255	3546	3227	4148	4511	2724	22·14	952	Yes	$\overline{EDBACF}$
5.	Bankal Estate, Mudegere	2188	2660	2496	2088	2311	1871	17·09	461	Yes	$\overline{BCEADF}$
1959											
1.	Cheekanahally Estate, Saklespur ..	5168	6256	6120	5916	6188	5508	14·72	2543	No	$\overline{BECDFA}$
2.	Harley Estate, Saklespur	2822	2876	3196	2958	2312	3196	12·23	1040	No	$\overline{FCBDA}$
3.	Panchura Estate, Kalpetta, Wynaad ..	4734	3551	3497	4035	3712	3066	11·10	1232	No	$\overline{ADEBCF}$
4.	Maniangode Estate, Kalpetta, Wynaad	2106	2268	2646	2592	2862	1512	8·70	551	Yes	$\overline{ECDBA}$, F
5.	Bankal Estate, Mudegere	6732	7276	7344	8092	5984	5984	10·32		No	$\overline{DCBAEF}$

APPENDIX XLIII

Analytical Data of the Leaf Samples Collected from the Foliar Feeding Trials
Samples collected during May 1957

Values on moisture-free basis (average of 3 replications)

Treatments		Total Nitrogen %				Total Phosphoric Acid %				Total Potassium %			
		*I Set	*II Set	*III Set	*IV Set	I Set	II Set	III Set	IV Set	I Set	II Set	III Set	IV Set
Young Leaves													
1. N_1	A	3·33	4·01	3·55	3·68	0·5738	0·7496	0·7446	0·6703	3·359	3·668	5·129	3·366
2. N_2	B	4·01	4·44	5·02	3·91	0·7680	0·7460	0·8796	0·7071	4·010	3·905	4·097	3·622
3. N_1P_1	C	4·29	4·68	4·51	4·23	0·6944	0·8994	0·7556	0·7365	3·931	3·962	4·632	4·009
4. N_2P_2	D	3·75	4·00	4·09	4·16	0·6161	0·7766	0·8693	0·7336	3·109	3·271	4·556	3·356
5. N_1K_1	E	3·85	3·94	3·83	3·85	0·5527	0·7217	0·7379	0·6439	3·380	3·281	4·552	3·195
6. N_2K_2	F	3·91	3·92	4·46	4·27	0·5898	0·9085	0·8259	0·7957	3·536	3·620	4·314	3·631
7. $N_1P_1K_1$	G	3·72	3·92	3·88	4·09	0·6109	0·8190	0·8226	0·6721	3·578	3·682	4·069	3·536
8. $N_2P_2K_2$	H	3·71	3·89	3·69	3·87	0·6709	0·9659	0·8479	0·6707	3·476	3·592	5·238	3·762
9. Control	I	3·27	3·83	3·89	3·75	0·6191	0·7855	0·7257	0·7040	3·632	3·823	4·361	3·649
10. Plain Water	J	3·93	4·16	4·10	4·35	0·7068	0·8323	0·7138	0·7867	4·264	4·188	4·780	4·194
Old Leaves													
1. N_1	A	3·08	3·40	3·59	3·57	0·4510	0·4704	0·4856	0·5034	2·510	3·117	3·374	3·244
2. N_2	B	2·91	3·69	3·39	4·03	0·3241	0·4346	0·3615	0·5428	2·211	3·162	3·004	3·484
3. N_1P_1	C	3·50	3·90	3·63	3·84	0·5559	0·5021	0·5045	0·5197	2·780	3·126	2·918	3·575
4. N_2P_2	D	2·66	3·23	3·66	3·33	0·3178	0·6437	0·4522	0·5008	1·919	3·254	2·610	3·008
5. N_1K_1	E	2·34	2·97	3·00	3·32	0·3113	0·3485	0·4064	0·6176	2·102	2·299	2·439	3·014
6. N_2K_2	F	3·36	3·50	3·85	3·92	0·3240	0·5005	0·5514	0·6115	2·585	2·620	3·102	3·447
7. $N_1P_1K_1$	G	2·77	3·56	3·31	3·58	0·2269	0·5734	0·5102	0·7854	2·153	3·600	3·360	3·646
8. $N_2P_2K_2$	H	3·17	3·98	3·88	3·51	0·5469	0·6705	0·5898	0·5453	3·066	4·021	3·769	3·305
9. Control	I	2·84	3·24	3·15	3·18	0·2849	0·4930	0·4623	0·5756	2·010	2·654	2·572	3·520
10. Plain Water	J	2·76	4·24	3·45	3·36	0·2791	0·5740	0·3925	0·4880	2·542	3·981	3·235	3·423

* I Set = Samples collected before treatment; * II Set = Samples collected 24 hours after treatment. * III Set = Samples collected 48 hours after treatment; * IV Set = Samples collected 96 hours after treatment.

1. A: N_1 20 lb. Nitrogen per acre sprayed as urea solution.
2. B: N_2 40 lb. Nitrogen per acre sprayed as urea solution.
3. C: N_1P_1 20 lb. as in A + 15 lb. P_2O_5 as ammonium phosphate.
4. D: N_2P_2 40 lb. N + 30 lb. P_2O_5 sprayed as above.
5. E: N_1K_1 20 lb. as in A + 20 lb. K_2O as Muriate of Potash.
6. F: N_2K_2 40 lb. N + 40 lb. K_2O as above.
7. G: $N_1P_1K_1$ 20 lb. N + 15 lb. P_2O_5 + 20 lb. K_2O.
8. H: $N_2P_2K_2$ 40 lb. N + 30 lb. P_2O_5 + 40 lb. K_2O.
9. I: Control no treatment.
10. J: Sprayed with the same quantity of plain water used for the above solutions

APPENDIX

Analytical Data of the Seedlings Collected

Averages of three replications

Sl. No.	Treatments	Description	Total Nitrogen %					
			I Set Aug. 1957	II Set Oct. 1957	III Set Dec. 1957	IV Set Feb. 1958	V Set April 1958	VI Set July 1958
1	N_0	Leaves ..	3·091	3·718	3·382	4·282	4·212	3·768
		Stalks ..	4·081	5·047	1·427	1·593	1·660	1·660
		Roots ..	1·715	1·523	2·017	2·064	1·688	1·644
2	$N_0P_0K_0$	Leaves ..	3·260	4·073	3·241	4·108	4·108	3·911
		Stalks ..	4·009	2·363	1·337	1·551	1·750	1·506
		Roots ..	1·945	1·537	1·890	1·783	1·613	1·416
3	N_1	Leaves ..	3·743	4·316	3·720	4·328	4·281	3·808
		Stalks ..	3·961	2·207	1·590	1·632	1·570	1·766
		Roots ..	1·882	1·752	2·419	1·797	1·779	1·431
4	$N_1P_1K_1$	Leaves ..	3·598	4·136	3·492	4·429	4·373	4·100
		Stalks ..	4·226	2·313	1·643	1·700	1·450	1·670
		Roots ..	1·861	1·682	2·061	1·763	1·909	1·426
5	N_2	Leaves ..	3·405	4·152	3·933	4·535	4·664	3·991
		Stalks ..	4·033	2·113	1·645	1·746	1·580	1·875
		Roots ..	1·978	1·646	2·248	2·139	2·013	1·494
6	$N_2P_2K_2$	Leaves ..	3·622	4·177	3·746	4·430	4·804	3·969
		Stalks	4·419	2·147	1·685	1·759	1·970	1·871
		Roots ..	1·984	1·743	2·211	1·717	1·910	1·506
7	N_3	Leaves ..	3·767	4·420	3·775	4·644	4·718	4·035
		Stalks ..	4·540	2·367	1·749	1·922	1·810	2·012
		Roots ..	1·929	1·866	2·246	1·821	1·992	1·543
8	$N_3P_3K_3$	Leaves ..	3·840	4·712	3·967	4·354	4·842	3·338
		Stalks ..	4·105	2·256	1·671	1·628	1·940	1·941
		Roots ..	1·792	1·760	2·382	1·992	2·001	1·620
9	N_4	Leaves ..	3·587	4·632	4·057	4·890	4·957	4·207
		Stalks ..	4·226	2·541	1·807	1·769	2·000	2·371
		Roots ..	2·015	1·920	2·251	1·813	1·995	1·832
10	$N_4P_4K_4$	Leaves ..	3·840	4·632	4·052	4·628	..	4·353
		Stalks ..	4·057	2·657	1·963	1·644	..	2·189
		Roots ..	2·002	1·879	2·369	1·898	..	1·727
11	N_5	Leaves ..	3·671	4·663	4·578	4·837	5·071	4·006
		Stalks ..	4·106	2·814	1·890	2·375	1·770	2·244
		Roots ..	2·002	1·940	2·189	1·948	2·028	1·801
12	$N_5P_5K_5$	Leaves ..	3·731	4·652	4·466	4·420	..	3·901
		Stalks ..	3·623	2·634	2·004	2·196	..	2·167
		Roots ..	1·941	1·880	2·415	2·044	..	1·873

I Set collected on 4—8–1957
II ,, ,, 4–10–1957
III ,, ,, 4–12–1957
IV ,, ,, 4—2–1958
V ,, ,, 5—4–1958
VI ,, ,, 30—6–1958 and 1–7–1958

XLIV

from the Nursery Manurial Trials—Series II

Values on moisture-free basis

Organic Carbon %						Carbon/Nitrogen					
I Set	II Set	III Set	IV Set	V Set	VI Set	I Set	II Set	III Set	IV Set	V Set	VI Set
43·14	45·82	43·91	40·70	41·26	54·76	13·8	12·0	13·0	9·6	9·8	14·5
39·06	42·25	47·02	49·99	49·70	44·07	9·7	8·3	32·9	31·5	30·0	26·7
44·80	41·10	45·42	45·98	46·15	48·26	26·2	27·1	22·9	22·5	27·6	29·4
43·48	46·49	43·88	39·97	40·08	55·82	13·3	11·5	13·6	9·8	9·8	14·2
38·82	42·98	46·81	49·80	48·89	44·54	9·4	10·0	35·1	32·2	28·2	29·4
44·72	40·89	45·41	45·41	46·10	47·58	23·1	26·6	24·2	25·5	28·7	34·0
43·69	47·22	43·63	42·00	38·85	53·74	11·7	10·7	11·7	9·9	9·1	14·1
39·60	38·80	47·39	49·82	47·61	45·59	10·2	17·8	29·8	30·6	30·4	25·8
45·26	40·64	44·93	45·77	46·17	47·12	24·11	23·23	20·76	25·74	25·95	33·05
42·98	45·42	43·70	43·45	41·14	55·53	12·2	11·0	12·5	9·9	9·5	13·6
38·98	41·32	46·74	50·01	47·18	45·62	9·6	11·9	28·5	29·5	32·5	27·3
45·06	40·34	45·17	45·25	48·12	47·10	24·2	24·2	21·5	25·9	24·2	33·1
42·71	46·64	43·52	41·66	40·96	52·98	12·9	11·3	11·1	9·2	8·9	13·3
39·15	41·17	46·74	49·41	46·95	45·14	9·7	19·6	28·5	28·5	29·7	23·8
45·10	40·20	44·30	46·67	45·21	46·43	22·8	24·8	18·8	21·9	22·5	31·2
42·25	46·02	41·73	41·20	41·75	52·78	12·5	10·7	11·2	9·3	8·7	13·3
39·08	36·73	46·40	49·98	47·09	44·52	8·9	16·6	28·2	28·4	23·1	24·1
44·92	40·49	45·40	46·65	46·59	46·63	22·5	23·4	20·6	27·2	24·4	31·1
42·61	45·59	42·50	40·81	41·43	53·60	11·4	10·3	11·3	8·9	8·8	13·3
39·43	39·97	47·05	42·78	48·33	45·83	8·8	17·0	27·1	26·0	26·7	22·8
44·59	41·31	49·22	45·36	47·70	46·27	23·1	22·2	22·1	24·9	23·9	30·0
43·42	48·80	41·05	39·54	42·87	53·42	11·4	10·4	9·9	9·5	8·9	16·3
39·47	41·26	46·69	49·80	46·59	44·80	9·9	18·3	28·1	29·5	24·0	23·2
45·51	40·66	47·18	44·02	44·73	46·30	25·4	23·1	20·8	22·1	22·4	27·8
42·45	46·06	41·36	40·23	41·47	53·15	13·9	10·0	10·2	8·2	8·4	12·7
38·86	40·59	46·83	50·24	47·56	45·88	9·2	16·6	26·1	26·3	23·8	19·4
44·77	40·91	46·48	43·94	46·59	47·22	22·3	21·5	20·7	24·2	23·4	25·8
42·36	45·74	43·35	41·35	..	50·30	10·9	9·8	10·8	9·0	..	11·6
39·28	41·55	46·59	49·67	..	44·10	9·7	15·6	23·3	27·1	..	20·2
45·20	40·39	46·31	43·84	..	45·41	22·7	21·5	19·9	23·1	..	26·3
41·79	44·08	45·66	39·40	40·29	48·78	11·4	9·5	10·0	8·2	8·0	11·9
39·22	46·65	46·75	51·31	46·97	46·28	9·7	16·6	25·4	21·4	26·5	20·7
45·47	40·97	45·65	44·32	46·83	45·17	22·8	21·3	20·5	22·8	23·1	25·2
42·14	44·29	44·46	39·69	..	52·42	11·4	9·5	9·9	9·0	..	13·4
39·28	39·76	46·74	51·84	..	45·62	10·9	15·1	23·4	24·8	..	21·1
44·33	41·14	45·12	44·39	..	46·24	22·9	22·0	19·1	21·7	..	24·7

APPENDIX XLV

Analytical Data of the Leaf Samples Collected from Different Blocks of Coffee Research Station to Correlate Yield with Leaf Nitrogen

Values on moisture-free basis

Name of the Block	Category	I Set collected before blossom				II Set collected after blossom			
		Total Nitrogen %	Total Ash %	Total P_2O_5 %	Total Potash %	Total Nitrogen %	Total Ash %	Total P_2O_5 %	Total Potash %
1. "J" Block ..	Medium	2·795	9·61	0·4135	3·061	2·820	9·50	0·3382	2·332
2. Crawford Area ..	Medium	3·099	9·70	0·4590	3·279	3·185	9·73	0·3604	2·515
3. "P" Block ..	High yielding	3·247	10·59	0·4345	2·486	2·970	12·48	0·3721	1·914
4. "M" Block ..	Medium	2·378	9·05	0·3779	2·507	2·943	9·51	0·2926	2·122
5. "N" Block ..	High yielding	2·878	10·48	0·3890	3·019	3·028	10·65	0·3550	2·448
6. "E" Block ..	Medium	2·729	10·59	0·4329	2·973	2·972	9·65	0·3964	2·590
7. "T" Block ..	High yielding	2·990	10·95	0·3713	2·761	3·159	9·48	0·3564	2·221
8. L-3 Valley ..	Low yielding	2·906	10·02	0·3851	2·139	3·031	10·37	0·3712	2·489
9. L-1 Block ..	Low yielding	2·821	10·82	0·4110	3·040	3·004	8·97	0·3541	2·289

Appendix XLVI

Analysis of Lechates from the Sub-Soil Drains of the New Manurial Series Plot 1958–59

Drain No.	Total flow during the year in imp. gallons	Plant Foods Lost							
		Total Nitrogen		Nitrates		Total P_2O_5		Total K	
		Total loss in gm.	Average loss per imp. gallon in mgm.	Total loss in gm.	Average loss per imp. gallon in mgm.	Total loss in gm.	Average loss per imp. gallon in mgm.	Total loss in gm.	Average loss per imp. gallon in mgm.
I	361107	5564	15·41	2663	7·37	578	1·60	3300	9·14
II	355481	3920	11·03	2261	6·36	269	0·76	3156	8·88
III	385370	6028	15·64	2782	7·22	419	1·09	2877	7·47
IV	289565	4397	15·18	2274	7·85	349	1·21	2468	8·52
V	358269	6721	18·76	4277	11·94	310	0·87	3001	8·38
Total ..	1749792	26630 or 58·81 lb.		14257 or 31·5 lb.		1925 or 4·2 lb.		14802 or 32·7 lb.	

Appendix XLVII

Incidence of Shot Hole Borer at the Coffee Research Station—1957–58 *and* 1958–59 (*August-July Comparative*)*

Season	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
1957–58	70	138	85	266	267	112	102	61	23	39	54	55
%	4·8	9·2	5·66	17·73	17·8	7·5	6·8	4·06	1·53	2·6	3·6	3·66
1958–59	107	128	136	169	192	150	94	34	13	12	10	12
%	7·13	8·53	9·06	11·26	12·8	10·0	6·26	2·27	0·86	0·8	0·66	0·8

* Infested twigs in 1,500 twigs examined per month.

Appendix XLVIII

Incidence of Red Borer-Z. coffeæ in the Selected Blocks at the Coffee Research Station (*July*, 1958–*June*, 1959)

Blocks	1958						1959						Total	Area	Infes. per acre
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June			
N.M.S. IV	0	0	0	0	2	0	0	0	1	0	2	4	9	0·82	10·99
N.M.S. V	1	1	2	0	0	1	1	6	19	10	34	6	81	2·06	40·5
L_2 Seed	1	0	0	2	0	1	0	1	6	2	14	17	44	5·25	8·38
1955 Seed	0	0	0	1	1	0	1	6	5	4	6	6	30	4·22	7·6
J.	0	4	0	1	0	1	1	0	3	4	9	4	27	2·24	12·0
Total ..	2	5	2	4	3	3	3	13	34	20	65	37	191	14·59	13·17

*Comparative Incidence of Red Borer—**Z. coffeæ** in the Selected Blocks and in the Rest of the Estate at the Coffee Research Station (July, 1958—June, 1959)*

Incidence	1958						1959						Total
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	
Selected Blocks (5) ..	2	5	2	4	3	3	3	13	34	20	65	37	191
Rest of the Estate ..	No tracing	3	2	7	4	No	tracing	2	19	3	58	19	117

APPENDIX L

*Effect of Systemic and Non-Systemic Organophosphates on the Green Bug, **C. viridis***

Treatments	Mean percentage mortalities obtained at			
	Low Concentration		High Concentration	
	15 days after treatment	25 days after treatment	15 days after treatment	25 days after treatment
A. Basudin 20% E.C. (0·03% and 0·06%) ..	40·00	36·84	60·68	61·32
B. Isochlorothion 50% E.C. (0·05% and 0·1%)	28·32	40·92	67·74	66·24
C. Paramar 50% E.C. (0·025% and 0·05%) ..	87·80	83·96	99·10	99·18
D. Fosferno 50% E.C. (0·015% and 0·03%) ..	88·76	77·20	99·84	100·00
E. Gusathion 20% E.C. (0·05% and 0·1%) ..	96·50	98·12	98·94	99·80
F. Folidol 46·7% E.C. (0·01% and 0·02%) ..	97·02	95·24	99·48	99·10
G. Meta-iso-systox 25% E.C. (0·025% and 0·05%)	56·36	44·06	96·44	95·90
H. Ekatin 20% E.C. (0·02% and 0·04%) ..	24·30	18·42	85·12	76·58
I. Control	0	0	0	0
General Mean	56·67	54·97	78·51	77·56
S.E.M.	8·7	8·04	3·87	5·7
Critical Difference	24·97	23·07	11·108	16·36
Significance	Yes**	Yes**	Yes**	Yes**
Conclusion	FEDCCABHI	EFCDGBAHI	DFCEGHBAI	DECFGHBAI

Appendix L (A)

Comparative Effectiveness of Folidol, Gusathion, Fosferno, Paramar, at Low and High Concentrations and Meta-Iso-Systox at High Concentration in 15 and 25 Days after Treatment on the Green Bug ***C. viridis***

Treatments	Mean percentage mortalities obtained by chemicals in the 1st group (App. L) at low and high concentrations in similar periods	
	15 days low concentration *vs.* 15 days high concentration	25 days low concentration *vs.* 25 days high concentration
Low Concentration		
1. F—Folidol	97·02	95·24
2. E—Gusathion	96·50	98·12
3. D—Fosferno	88·76	77·20
4. C—Paramar	87·80	83·96
High Concentration		
5. D—Fosferno	99·84	100·00
6. F—Folidol	99·48	99·10
7. C—Paramar	99·10	99·18
8. E—Gusathion	98·94	99·80
9. G—Meta-iso-systox	96·44	95·90
General Mean	95·98	94·27
S.E.M.	1·5	0·8
Critical Difference	4·30	2·27
Significance	Yes**	Yes**
Conclusion	5 6 7 8 1 2 9 3 4	5 8 7 6 2 9 1 4 3

Appendix LI

Effect of Systemic and Non-Systemic Organophosphates on the Mealy Bug, ***P. citri*** *(Laboratory)*

Treatments	Mean Percentage mortalities obtained at			
	Low Concentration		High Concentration	
	8 Hours after treatment	48 Hours after treatment	8 Hours after treatment	48 Hours after treatment
A. Fosferno 50% E.C. (0·015% and 0·03%) ..	0	26·7	12·1	44·5
B. Paramar 50% E.C. (0·025% and 0·05%) ..	10·0	44·5	21·0	31·1
C. Basudin 20% E.C. (0·03% and 0·06%) ..	29·2	51·1	31·7	57·8
D. Isochlorothion 50% E.C. (0·05% and 0·1%)	5·0	33·3	21·0	20·0
E. Ekatin 20% E.C. (0·02% and 0·04%) ..	13·9	48·9	35·0	42·2
F. Meta-iso-systox 25% E.C. (0·025% and 0·05%)	13·9	28·9	20·3	33·3
G. Gusathion 20% E.C. (0·05% and 0·1%) ..	24·6	22·2	29·6	48·9
H. Folidol E-605 46·7% E.C. (0·01% and 0·02%)	24·9	40·0	29·6	40·0
I. Control	0	0	0	0
General Mean	13·5	32·7	22·2	35·3
S.E.M.	5·29	5·47	5·91	8·24
Critical Difference	15·78	16·39	17·76	24·77
Significance	Yes*	Yes**	Yes*	Yes**
Conclusion	CHGEFBDAI	CEBHDFAGI	ECGHBDFAI	CGAEHFBDI

Appendix LII

Comparative Effectiveness of Systemic and Non-Systemic Organophosphates on the Root Mealy Bug, ***P. citri*** *in the Field*

Treatments		Degrees of ant movement (i) and bug population (ii)							
		Initial		A week after initial		10 days after initial		15 days after initial	
		L.C.	H.C.	L.C.	H.C.	L.C.	H.C.	L.C.	H.C.
A. Control	(i)	A	A	A	A	A	A	A	A
	(ii)	A	A	A	A	A	A	A	A
B. Basudin 20% E.C. (0·03% and 0·06%)	(i)	A	A	P	P	P	P	P	P
	(ii)	A	A	N	N	N	N	N	N
C. Paramar 50% E.C. (0·025% and 0·05%)	(i)	A	A	M	M	M	M	A	M
	(ii)	A	A	N	M	M	M	M	M
D. Gusathion 20% E.C. (0·05% and 0·1%)	(i)	A	A	P	P	P	P	P	P
	(ii)	A	A	N	N	N	N	N	N
E. Ekatin 20% E.C. (0·02% and 0·04%)	(i)	A	A	A	M	A	P	M	M
	(ii)	A	A	N	N	N	N	N	N
F. Folidol 46·7% E.C. (0·01% and 0·02%)	(i)	A	A	A	M	A	M	M	M
	(ii)	A	A	N	N	N	N	N	N
G. Meta-iso-systox 25% E.C. (0·025% and 0·05%)	(i)	A	A	M	A	M	A	M	M
	(ii)	A	A	A	M	M	M	M	P
H. Fosferno 50% E.C. (0·015% and 0·03%)	(i)	A	A	A	M	A	M	A	A
	(ii)	A	A	N	N	N	N	N	N
I. Isochlorothion 50% E.C. (0·05% and 0·1%	(i)	A	A	M	M	A	M	A	M
	(ii)	A	A	A	A	M	A	M	A

A—Appreciable; M—Moderate; P—Poor; N—Nil; L.C.—Low Concentration; H.C.—High Concentration.

Appendix LIII

*Effect of the Systemics, Meta-Iso-Systox and Ekatin on the Incidence of Shot Hole Borer, **X. morstatti***

	Treatments	Mean percentages of reduction from initial obtained in (i) January 1959 (One month after initial on all plants—one application in December 1958)	(ii) February 1959 (Two months after initial on one plant in each plot—one application in December 1958)	(iii) February 1959 (Two months after initial on one plant in each plot—one application in December and another in January)
A.	Meta-sio-systox 25% E.C. (at 0·1%)	60·8	76·6	68·9
B.	Ekatin 20% E.C. (at 0·04%) ..	59·2	72·9	89·3
C.	Control	26·2	62·4	62·4
	General Mean	48·7	70·6	76·8
	S.E.M.	2·29		3·7
	Critical Difference ..	7·62	..	12·695
	Significance	Yes**	Not Significant	Yes*
	Conclusion	A B C		B A C

Appendix LIV

*Effect of Chemicals on the IV, V and VI Instar Hairy Caterpillar, **E. fabia***

Treatments	Mean percentage mortalities obtained in various series at different hours after treatment					
	Series I		Series II		Series III	
	4 hours	8 hours	4 hours	8 hours	4 hours	8 hours
A. Folidol ..	66·13	83·86	72·2	77·7	75·00	45·0
B. D.D.T. ..	25·06	77·73	15·0	57·0	6·13	34·1
C. Dieldrex ..	75·00	90·00	43·0	68·8	32·20	48·8
D. Chlordane ..	26·60	57·00	6·1	28·0	0	15·0
E. B.H.C. ..	50·86	77·73	28·1	59·5	8·80	37·1
F. Heptachlor ..	45·26	65·86	21·1	39·0	6·13	15·0
G. Malathion ..	66·60	75·00	45·0	53·1	26·60	39·1
H. Dipterex ..	83·80	90·00	..	..	..	..
Basudin ..	..	..	52·8	66·1	15·00	33·0
I. Control ..	0	0	0	0	0	0
General Mean ..	48·81	68·57	31·4	49·8	18·31	29·6
S.E.M. ..	7·8	6·1	5·65	4·79	6·3	8·78
Critical Difference	23·15	18·10	16·75	14·204	18·86	26·2
Significance ..	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**
Conclusion ..	HCGAEFDBI	CHABEGFDI	AHGCEFBDI	ACHEBGFDI	ACGHEBFDI	CAGEBHDFI

Appendix LV

*Effect of Organophosphates, Paramar, Fosferno, Gusathion and Malathion on the VII Instar Caterpillar, **E. fabia***

Treatments	Mean percentage mortalities obtained at 24 hours after treatment
A. Fosferno 50% E.C. (0·03%)	45·0
B. Malathion 50% E.C. (0·15%)	26·6
C. Paramar 50% E.C. (0·05%)	90·0
D. Gusathion 20% E.C. (0·1%)	71·6
E. Control	0
General mean	46·64
S.E.M.	8·2
Critical Difference	32·24
Significance	Yes**
Conclusion	C D A B E

APPENDIX LVI

Effect of Nemagon on Eelworms, Parasitic on Coffee

Months	Treatments	Depth Counts Average			Total
		0–9″	9–18″	18–27″	
April, 1957 ..	Control A	27·3	9·6	2·9	39·8
	Nemagon B	16·7	5·8	3·3	25·8
	TOTAL ..	44·0	15·4	6·2	65·6
June, 1957	A	66·8	26·6	28·2	121·6
	B	35·5	15·1	7·5	58·1
	TOTAL ..	102·3	41·7	35·7	179·7
November, 1957 ..	A	84·3	41·3	32·6	158·2
	B	27·8	8·4	6·9	43·1
	TOTAL ..	112·1	49·7	39·5	201·3
April, 1958 ..	A	4·4	2·2	1·8	8·4
	B	2·2	2·2	1·4	5·8
	TOTAL ..	6·6	4·4	3·2	14·2
June, 1958	A	71·9	71·7	53·7	197·3
	B	53·4	54·9	17·9	126·2
	TOTAL ..	125·3	126·6	71·6	323·5
October, 1958 ..	A	13·3	1·8	8·7	23·8
	B	9·1	2·2	3·3	14·0
	TOTAL ..	22·4	4·0	12·0	38·4
	GRAND TOTAL ..	412·7	241·8	168·2	822·7

Critical difference : (5%) = 80·65.

Treatments : Significance—Yes**. (A) = 549·1; (B) = 273·6.

Depths : Significance—Yes**. 0–9″ = 412·7; 9–18″ = 241·8: 18–27″ = 168·2.

Months : Significance—Yes**.

June 1958	Nov. 1957	June 1957	April 1957	Oct. 1958	April 1958
323·5	201·3	179·7	65·6	38·4	14·2

APPENDIX LVI (A)

Nemagon/Interaction Depths and Treatments

Treatments	Depths			Total
	0–9″	9–18″	18–27″	
A. Control ..	268·0	153·2	127·9	549·1
B. Nemagon ..	144·7	88·6	40·3	273·6
TOTAL ..	412·7	241·8	168·2	822·7

The first depth is highly populated in both the treatments.

APPENDIX LVI (B)

Nemagon/Interaction, Depths and Months

Months	Depths			Total
	0–9″	9–18″	18–27″	
April, 1957 ..	44·0	15·4	6·2	65·6
June, 1957 ..	102·3	41·7	35·7	179·7
November, 1957	112·1	49·7	39·5	201·3
April, 1958 ..	6·6	4·4	3·2	14·2
June, 1958 ..	125·3	126·6	71·6	323·5
October, 1958 ..	22·4	4·0	12·0	38·4
TOTAL ..	412·7	241·8	168·2	822·7

The first depth is highly populated in the months, January 1957, November 1957 and June 195

APPENDIX LVI (C)

Nemagon/Interaction, Months and Treatments

Treatments	Months						Total
	April 1957	June 1957	Nov. 1957	April 1958	June 1958	Oct. 1958	
A. Control	39·8	121·6	158·2	8·4	197·3	23·8	549·1
B. Nemagon	25·8	58·1	43·1	5·8	126·2	14·6	273·6
TOTAL ..	65·6	179·7	201·3	14·2	323·5	38·4	822·7

Treatment A shows high counts for all the months as compared with Treatment B.

Appendix LVII

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality : L_1 Block, Coffee Research Station, Balehonnur.
Replications : 5.
Treatment : 10.
Lay-out : Randomized Block.

Started : June 1956.
Plot Size : Gross: 3 rows of 3 plants = 9. Net: Middle plant in middle row.

	Treatments	Effective percentage of leaf survival						
		Initial June 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	Sept. 1958	Feb. 1959
A.	Cuprokylt—0·25%	72·35	45·90	42·05	44·55	38·25	19·51	26·80
B.	M.C.M. Copper Oxy. Chloride—0·25%	75·35	42·18	47·75	41·38	37·00	19·57	28·91
C.	Colloidal Copper—0·25% (Bharat's)	71·55	47·14	48·30	42·25	39·50	19·18	27·56
D.	Flit-406—0·2% + Ortho-sticker ..	76·45	41·46	49·60	45·01	44·25	19·21	31·66
E.	,, 0·4% + ,, ..	71·80	39·30	51·20	38·04	45·25	19·45	31·91
F.	Ultra Sulphur—1 lb. in 60 gal. water	73·40	34·40	37·85	36·25	29·00	17·37	26·33
G.	Bordeaux—0·5%	72·85	56·16	45·55	47·13	37·50	26·18	28·83
H.	,, + Tenac Sticker	74·95	57·08	49·75	49·27	39·00	27·34	31·49
I.	,, + Ortho-sticker	73·90	56·88	56·25	49·50	43·50	27·14	29·24
J.	Control—No Spray	71·40	35·00	35·75	29·63	28·50	13·43	25·41
	General Mean	..	45·55	46·40	42·30	38·18	20·83	28·83
	S.E.M.	..	3·94	3·73	3·02	2·72	1·71	3·10
	Significance	..	Yes**	Yes**	Yes**	Yes**	Yes**	No
	Critical Difference at 5% ..	..	7·72	7·31	8·37	7·54	4·87	No
	Conclusions		HIG CAB DEJ F	IEH DCBG AFJ	IHGD ACBE FJ	EDI CHAG BFJ	HIG BAED CFJ	..

APPENDIX LVIII

Spray Experiment to Compare the Efficacy of Blitox Ipsilon with Bordeaux Mixture

Locality: Crawford Area, Coffee Research Station, Balehonnur. *Plot Size:* Gross: 3 rows of 3 plants = 9; Nett: Middle plant in middle row.
Replications: 5. *Lay-out:* Randomized Block.
Treatments: 9. *Started:* June 1959.

Treatments	Effective percentage of leaf survival						
	Initial June 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	Sept. 1958	Feb. 1959
A. Blitox Ipsilon at 5 lb. in 300 gal. per acre	89·90	48·80	40·00	49·44	32·00	26·26	34·74
B. ,, at 10 lb. in 300 gal. per acre	85·50	48·70	40·15	40·56	37·25	29·04	36·50
C. ,, at 15 lb. in 300 gal. per acre	85·60	43·70	44·20	52·55	33·75	24·12	36·58
D. ,, at 5 lb. in 400 gal per acre	84·30	45·40	36·85	44·62	33·50	28·25	36·80
E. ,, at 10 lb. in 400 gal. per acre	84·10	50·60	40·50	43·34	30·75	25·52	34·58
F. ,, at 15 lb. in 400 gal. per acre	88·85	46·40	41·70	46·22	31·00	28·39	37·91
G. Bordeaux mixture ½% at 400 gal. per acre	86·35	55·50	46·70	56·77	32·75	29·28	34·41
H. Control—No Spray	86·65	40·20	34·00	40·13	31·50	24·11	29·25
I.* Bordeaux mixture ½% at 300 gal. per acre	*	*	49·20	48·04	33·75	27·95	33·16
General Mean	..	46·42	41·48	46·85	32·92	27·00	34·90
S.E.M.	..	5·57	5·03	2·78	3·10	2·54	2·97
Significance	..	No	No	Yes**	No	No	No
Critical Difference at 5%	..	..	..	7·70	..	..	..
Conclusions	..			GCAIFDEBH			

* This treatment was included only during September 1956 spray application.

APPENDIX LIX

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: 'Q' Block, Coffee Research Station, Balehonnur.

Replications: 5. *Started:* May, 1957.

Treatments: 5. *Plot Size:* Gross: 6 rows of 5 plants = 30.
Nett: Middle 5 plants.

Treatments	Effective percentage of leaf survival		Mean percentage of diseased leaves	
	September 1958	February 1959	September 1958	July 1959
A. Cobredon ..	40·17	29·75	90·4	32·7
B. Cupricol	38·64	31·66	86·0	46·0
C. Dithane M. 22 (4 applications) ..	42·44	29·33	87·6	28·0
D. Bordeaux 0·5% ..	41·37	29·49	88·8	9·4
E. Control	27·46	27·08	95·7	44·5
General Mean ..	38·00	29·50		
S.E.M.	1·77	2·02		
Significance ..	Yes**	No		
Critical Difference at 5%	5·30	..		
Conclusions ..	$\overline{\text{CDABE}}$	..		

APPENDIX LX

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Coffee Research Sub-Station, Chethalli.

Replications: 4. *Lay-out:* Randomized Block.

Treatments: 9. *Started:* May, 1957.

Plot Size: Gross: 3 rows of 5 plants = 15. Nett: Middle 3 plants of middle row.

	Treatments	Effective percentage of leaf survival	
		September 1958	February 1958
A.	Flit-406—0·2% (2 sprays a year)	66·6	68·9
B.	do. 0·4% do.	71·2	70·0
C.	do. 0·6% do.	57·1	64·5
D.	do. 0·4% + Tenac do.	61·9	65·5
E.	Bordeaux mixture 0·5% (2 sprays a year) ..	64·5	72·0
F.	do. 0·5% + Tenac (4 sprays a year)	71·1	57·8
G.	Kirti-Copper 1 lb. in 40 gal. (2 sprays a year) ..	64·9	58·9
H.	Control	59·0	72·7
I.	Flit-406—0·4% + Tenac (4 sprays a year) ..	66·9	62·6
	General Mean	64·8	65·8
	S.E.M.	6·01	6·16
	Significance	No	No
	Critical Difference at 5%	..	..
	Conclusions	..	..

APPENDIX LXI

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Coffee Research Sub-Station, Chethalli.

Replications: 5. *Lay-out:* Randomized Block.

Plot Size: Gross: 3×3 = 9 plants. *Treatments:* 8.

Net: Middle plants. *Started:* May 1958.

Treatments	Effective percentage of leaf survival	
	September 1958	February 1959
A. Cobredon—17·6 oz. in 40 gal. water ..	39·9	45·7
B. Cupricol—1 lb. in 40 gal. water	41·0	49·2
C. Parry-Cop 50·1 lb. in 40 gal. water	45·8	50·3
D. Dithane M-22 at 4 lb. in 100 gal. water ..	41·4	45·1
E. Bordeaux 0·5%	46·2	45·3
F. Bordeaux + Triton x-114	47·6	55·1
G. Dithane M-22—0·4% (4 sprays a year) ..	52·3	51·3
H. Unsprayed Control	41·2	44·8
General Mean	44·4	48·3
S.E.M.	5·14	4·09
Significance	No	No
Critical Difference at 5%	..	..
Conclusions	..	..

Appendix LXII

Spray Trial to find out a Suitable Time Schedule under N.E. Monsoon Conditions

Locality : Belvidre Estate, Shevaroys. *Plot Size :* Gross: 6 rows of 16 plants = 96;

Replications : 6. *Lay-out :* Randomized Block. Nett: 4 rows of 14 plants = 56.

Treatments : 5. *Started :* May 1957.

Treatments	Effective percentage of leaf survival			Yield of ripe cherry in lb. per acre		
	Initial May 1957	Feb. 1958	Sept. 1958	Feb. 1959	1957–58 (Basic)	1958–59
A. Three Bordeaux Sprays—1%—April-May; August-September; and November ..	92·00	76·5	87·3	63·2	1327	6268
B. Two Bordeaux sprays—June-July and November	91·00	72·7	79·8	44·5	1182	7320
C. Two Brodeaux sprays—April-May and September	92·00	94·5	85·3	36·2	982	6965
D. One Bordeaux spray—June-July	89·00	79·7	78·7	34·6	1093	6770
E. Unsprayed Control	93·00	43·8	65·1	20·0	1196	4312
General Mean		73·4	79·2	39·7	..	6327
S.E.M.		7·0	4·93	3·14	..	576·4
Significance		Yes**	Yes*	Yes**	..	Yes*
Critical Difference at 5%		20·7	14·55	9·26	..	1703
Conclusions		CDABE	ACBDE	ABCDE		BCDAE

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